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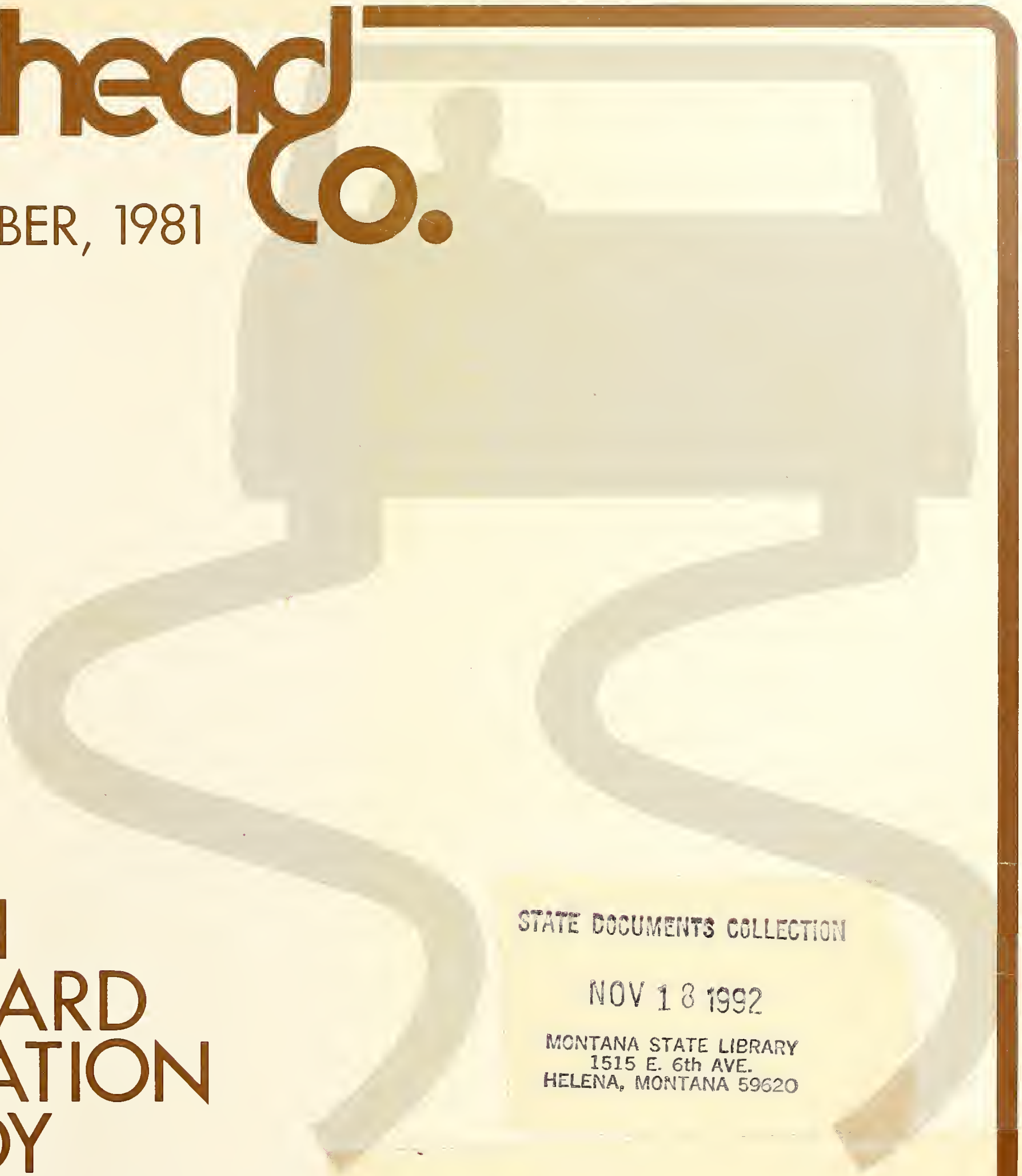
1981 high hazard
location study

Flathead Co.

DECEMBER, 1981



HIGH HAZARD LOCATION STUDY

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Planners - Engineers - Designers
P.O. BOX 4518 810 HIALEAH COURT
HELENA, MONTANA 59604 406/442-8160

March 5, 1982

Charles H. Phillips, Maintenance Superintendent
Flathead County Road Department
P.O. Box 1102
Kalispell, Montana 59901

Dear Mr. Phillips:

Transmitted herewith are 20 copies of the final report for the Flathead County High Hazard Location Study. This report documents the results of the traffic studies and surveys performed in the evaluation of 22 locations in Flathead County.

Included in this report are: 1) a thorough assessment of the existing conditions at each site; 2) an accident analysis of all reported accidents at each site during the three-year period from January, 1978 through December, 1980; 3) a short-term, low-cost improvement program complete with a prioritized project list based on the relative hazardousness of each site; and 4) a series of long-term, more expensive solutions, generally involving reconstruction and realignment.

It has been a pleasure working with you, and we appreciate your guidance throughout the project. We hope you are satisfied with the product and find it useful in reducing traffic hazards in Flathead County. If you desire additional information or if we can be of further assistance to Flathead County in implementing these improvements, please contact us at your convenience.

Respectfully submitted,

ROBERT PECCIA & ASSOCIATES

Robert J. Peccia

Robert J. Peccia, President

Douglas E. Widmayer

Douglas Widmayer, Project Engineer

DW/gp

FLATHEAD COUNTY HIGH HAZARD LOCATION STUDY

Prepared For:

Flathead County, Montana

In Cooperation With:

State of Montana Department of Justice
Traffic Safety Division

Prepared By:

Robert Peccia & Associates
Helena, Montana

December, 1981

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Photo plates are included for each site in their appropriate sections.

INTRODUCTION

CHAPTER I

INTRODUCTION

The purpose of this report is to evaluate 22 hazardous road locations in Flathead County and to recommend appropriate improvements. The sites were chosen by Flathead County with the assistance of the Department of Justice, Highway Traffic Safety Division, based on accident history and roadway characteristics. The sites are referenced in Table 1 on the following page and shown on a location map, Figure I-1.

The analysis contained within this report is based on procedures outlined in Report No. FHWA-RD-77-83, Identification of Hazardous Locations, as refined by DCA Project No. 79-04-01-01, Preliminary Evaluation Program for High Hazard Location Study, Yellowstone County, Montana.

Short-term and in some cases long-term improvements that would reduce or eliminate hazardous conditions have been included for each site. Emphasis was given to relatively low-cost improvements in an effort to present solutions within the funding capabilities of the County. A priority ranking of site improvement projects was developed based on a composite hazard ranking and cost-benefit ratios.

TABLE NO. 1

LIST OF SITES

Site #1:	Air Force Road, Lakeside
Site #2:	Intersection of Montana 35 (FAP 52), Holt Road, and Electric Avenue, Big Fork
Site #3:	Boon Road, Somers
Site #4:	Foys Canyon Road (FAS 503)
Site #5:	Intersection of Kila Road and Spring Hill Road
Site #6:	Intersection of Willow Glen Drive (FAS 317) and Woodland Avenue (FAU 6726)
Site #7:	Intersection of Conrad Drive (FAU 6715) and Willow Glen Drive (FAS 317)
Site #8:	Intersection of Conrad Drive (FAU 6715) and Anderson Lane
Site #9:	South Whitefish Stage Road (FAU 6728)
Site #10:	West Cottonwood Drive
Site #11:	Intersection of Helena Flats Road (FAU 6712) and Evergreen Drive (FAU 6710)
Site #12:	Intersection of U.S. 93 (FAP 5) and West Reserve Drive (FAS 548)
Site #13:	West Reserve Drive (FAS 548)
Site #14:	North Whitefish Stage Road
Site #15:	Columbia Falls Stage at Red Bridge
Site #16:	Tamarack Lane
Site #17:	Armory Road, Whitefish
Site #18:	Intersection of Twin Bridges Road (FAS 424) and K.M. Ranch Road

TABLE NO. 1
(cont.)

Site #19:	Big Mountain Road, Lower Switchback
Site #20:	Big Mountain Road, Upper Switchback
Site #21:	East Lake Shore Drive at Hell Roaring Creek
Site #22:	East Lake Shore Drive

FLATHEAD COUNTY SITE LOCATIONS

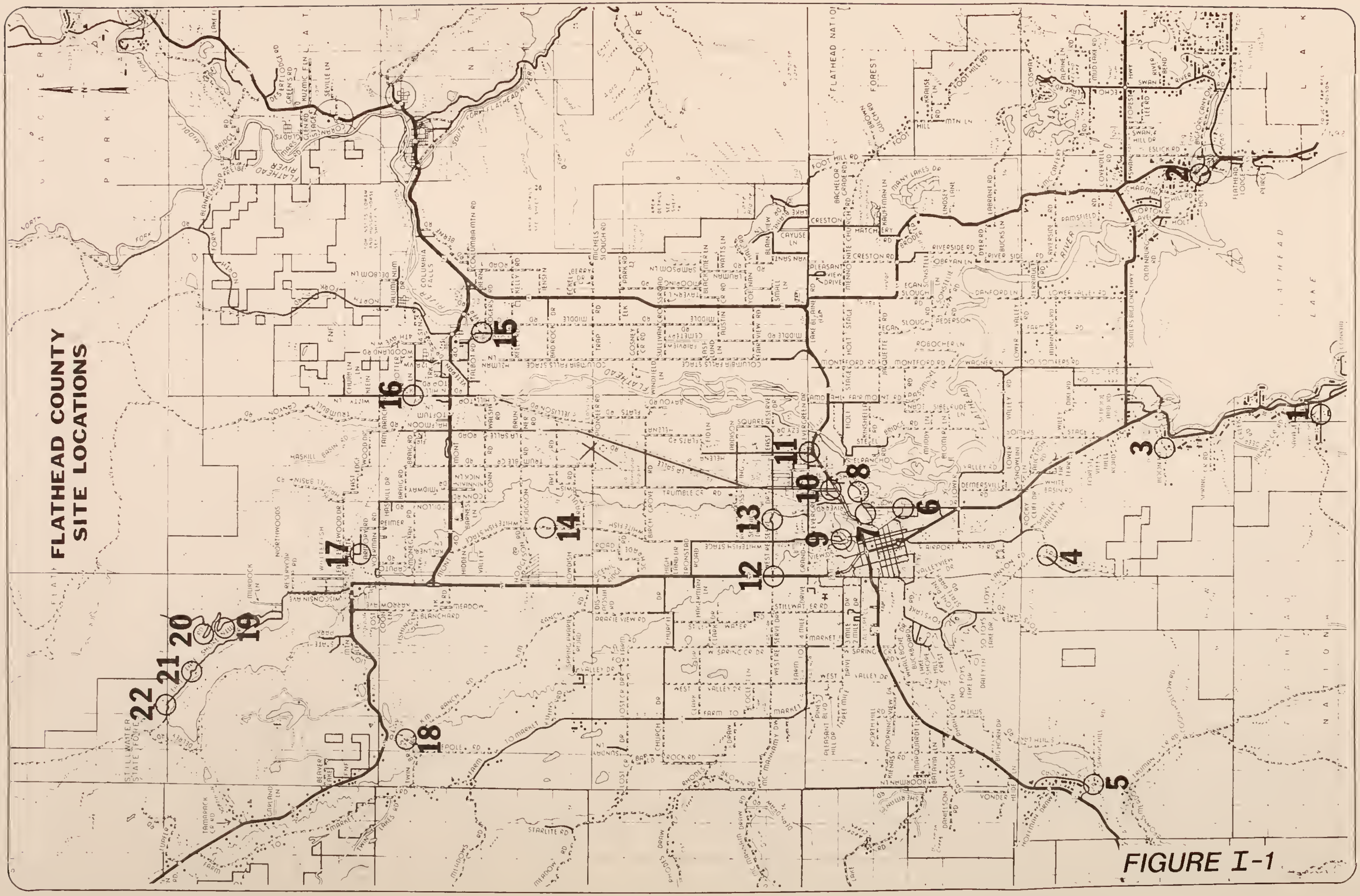


FIGURE I-1

SUMMARY AND RECOMMENDATIONS

CHAPTER II

SUMMARY AND RECOMMENDATIONS

A. Summary

The objective of this High Hazard Location Study is to identify the factors contributing to unsafe traffic conditions at 22 hazardous locations selected by Flathead County, and to recommend improvements that would remedy the unsafe conditions. For each site a field inspection was made, field measurements were taken, site condition sketches made, manual and machine traffic counts taken, accidents investigated, and specific problems identified.

Solutions to the problems that were identified included short-term, low-cost traffic management-type improvements, and long-term, more permanent solutions generally involving reconstruction and higher costs. These recommended improvements are contained in Table 2.

The 22 hazardous sites selected by Flathead County had 113 accidents during the three-year period from 1978 through 1980. These included one fatal, 44 injury, and 68 property damage accidents. The annual cost of these accidents, according to National Safety Council figures, is $165,000. Based on criteria established by the Montana Department of Highways, the short-term safety improvements recommended in this report could eliminate one-half of these accidents.

B. Short-Term Improvements

The short-term improvements recommended for each site concentrate on supplying better guidance to the motorist through conventional signing and striping methods and on improving sight distance within existing right-of-way limits. In general, the short-term improvements for each site cost less than $2,000. The total cost of all short-term improvements is $42,170.00.

C. Long-Term Improvements

Long-term improvements were recommended in cases where deficiencies at a location could not be addressed by short-term improvements. In general, these improvements consist of roadway reconstruction or realignment to achieve the necessary sight distance or desired geometrics. In many cases, these long-term improvements involve the acquisition of additional right-of-way or easements. Due to the nature and the time frame involved with these long-term improvements, it is recommended that they be done as funds and/or right-of-way become available. The total cost to implement all of the long-term improvements is $248,358.00, based on 1981 construction costs.

D. Prioritization

To aid the County in deciding the order of implementation for the short-term improvements, a Priority Ranking has been provided. This rank-

TABLE NO. 2

SHORT- & LONG-TERM IMPROVEMENT COSTS

Site No.	Site Name	Short-Term Improvement Cost	Long-Term Improvement Cost
1	Air Force Rd.	$1,642	*
2	Big Fork Int.	760	20,600
3	Boon Road	2,287	2,000
4	Foys Canyon	3,855	11,200
5	Kila Rd.	967	6,900
6	Willow Glen & Woodland	1,640	13,240
7	Conrad & Willow Glen	1,273	15,100
8	Conrad & Anderson	3,250	4,000
9	S. Whitefish Stage	3,980	20,000
10	Cottonwood Dr.	2,113	*
11	Helena Flats & Evergreen	1,574	*
12	US 93 & W. Reserve	955	*
13	W. Reserve	1,828	*
14	N. Whitefish Stage	3,218	51,000
15	Red Bridge	2,144	*
16	Tamarack Lane	2,352	36,400
17	Armory Rd.	973	7,900
18	Twin Bridges Rd.	1,730	15,300
19	Lower Big Mtn.	2,516	*
20	Upper Big Mtn.	1,504	7,000
21	Hell Roaring Cr.	3,013	31,755
22	E. Lake Shore Dr.	508	5,963
Total Cost:		$44,082	$248,358

* No long-term improvements are recommended for this site.

ing evaluates the relative hazardousness of each site and the cost of the short-term improvements.

To evaluate the relative hazardousness of each site, a Hazard Index was calculated. This Hazard Index is based on three accident indicators (number of accidents, accident severity, and accident rate) and four "non-accident" indicators (volume/capacity ratio, sight distance ratio, driver expectancy, and information system deficiency). Each site has been ranked according to the accident and non-accident indicators, and the Hazard Index is shown in Table 3.

To determine the proper order of implementation for the short-term improvements, the cost of the improvement must be evaluated with respect to the average traffic volume and the site's Hazard Index. Cost factors and benefit/cost ratios were calculated for each site improvement, and are shown in Table 4.

A Priority Index, which is a weighted average of the Hazard Index and the Cost Factor, was computed for each site. The Priority Index ranking is the recommended order of implementation and should be used as the major consideration in selecting the order of funding for these sites. Due to possible funding limitations, it may be advantageous to skip one or two improvement projects in order to implement a greater number of improvements. The Priority Index ranking of the short-term improvements is shown in Table 5.

No prioritization has been offered for the long-term improvements due to the costs involved and the unpredictability of the acquisition of right-of-way. It is recommended that the long-term improvements be implemented as funds and/or right-of-way become available.

E. Implementation

The short-term improvements recommended in this report address the major problems at each site. After evaluating the availability of funds, Flathead County should schedule the implementation of the short-term improvement projects according to the priority listing shown in Table 5. Due to the relatively low cost of these improvements, it is believed that implementation could be scheduled over a two- to three-year period without becoming a financial burden on the County. It is recommended to complete the short-term improvement program prior to funding any of the long-term improvements.

The short-term improvements are intended to greatly reduce the potential hazards at each location. In one case (Site #6, the intersection of Willow Glen Drive and Woodland Avenue), the potential hazards could not be adequately addressed by a low-cost, short-term solution. The sight distance limitations at this intersection are so severe that the only true solution is to reconstruct the intersection. Although the reconstruction of this intersection is somewhat expensive ($13,000), no additional right-of-way is required. Due to the unique nature of the problem at this location, it is strongly recommended that the long-term improvement for Site #6 be given special consideration with respect to the sequence of implementation of long-term improvements. All other long-term improvements are considered of equal importance and should be implemented as funds and/or right-of-way become available.

TABLE NO. 3

HAZARD INDEX RANKING

Ranking	Site No.	"Non-Accident" Indicators	Site No.	"Accident" Indicators	Site No.	Hazard Index
1	20	32.12	20	45.69	20	77.81
2	4	31.64	19	44.17	21	71.55
3	6	29.41	14	43.36	14	70.69
4	21	28.95	17	42.81	3	69.30
5	3	28.24	21	42.60	19	69.09
6	13	27.79	16	41.35	16	67.04
7	15	27.52	3	41.06	9	64.45
8	18	27.40	22	39.80	15	62.06
9	14	27.33	9	39.71	13	60.69
10	11	27.01	15	34.54	4	58.06
11	2	25.74	1	34.24	6	56.57
12	16	25.69	13	32.90	17	55.45
13	19	24.92	8	31.67	22	52.59
14	9	24.74	4	31.03	1	52.22
15	10	24.12	6	27.16	2	51.73
16	5	23.31	2	25.99	11	44.35
17	7	20.45	12	21.12	12	41.03
18	12	19.91	11	17.34	8	40.66
19	1	17.98	7	14.02	7	34.47
20	22	12.79	5	0.00*	27	27.40
21	17	12.64	10	0.00*	10	24.12
22	8	8.99	18	0.00*	5	23.31

* No accidents were reported at this site; therefore, the Accident Indicator is zero.

TABLE NO. 4

BENEFIT/COST RANKING

Ranking	Site No.	Short-Term Improvement Cost	Cost Factor Indicator	Benefit/Cost Ratio
1	9	$3,980	100	14.87
2	8	3,250	100	11.07
3	20	1,504	98	10.70
4	17	973	94	7.48
5	3	2,287	50	7.35
6	22	508	98	7.40
7	14	3,218	94	5.10
8	16	2,352	92	4.71
9	15	2,144	98	3.69
10	21	3,013	84	3.63
11	19	2,516	96	2.95
12	1	1,642	94	2.94
13	13	1,828	100	2.37
14	6	1,640	100	2.24
15	2	760	100	0.91
16	12	955	100	0.36
17	4	3,855	82	0.23
18	11	1,574	100	0.18
19	7	1,273	100	0.17
20	18	1,730	96	0.00*
21	5	967	100	0.00*
22	10	2,113	96	0.00*

* There were no accidents at this site; therefore, the Benefit/Cost Ratio is zero.

TABLE NO. 5

PRIORITY RANKING OF SHORT-TERM IMPROVEMENTS

Priority Ranking	Site No.	Site Name	Short-Term Improvement Cost	Priority Index
1	20	Air Force Rd.	$1,504	82.86
2	14	Big Fork Int.	3,218	76.52
3	19	Boon Rd.	2,516	75.82
4	21	Foys Canyon Rd.	3,013	74.60
5	9	Willow Glen & Woodland	3,980	73.34
6	16	Kila Rd.	2,352	73.28
7	15	Conrad & Willow Glen	2,144	71.05
8	13	Conrad & Anderson	1,828	70.52
9	6	S. Whitefish Stage	1,640	67.43
10	17	Cottonwood Dr.	973	65.09
11	3	Helena Flats & Evergreen	2,287	64.48
12	4	U.S. 93 & W. Reserve	3,855	64.05
13	22	W. Reserve	508	63.94
14	2	N. Whitefish Stage	760	63.80
15	1	Red Bridge	1,642	62.67
16	11	Tamarack Ln.	1,574	58.26
17	12	Armory Rd.	955	55.77
18	8	Twin Bridges Rd.	3,250	55.50
19	7	Lower Big Mtn.	1,273	50.85
20	18	Upper Big Mtn.	1,730	44.55
21	5	E. Lake Shore Dr.	967	42.48
22	10	Hell Roaring Cr.	2,113	42.09

Throughout this report, when warning signs are recommended, the 30" x 30" size sign is to be used. Likewise, all advisory speed plates should be of the 18" x 18" size. The placement of all signs, delineators, guard rails, and pavement markings should always be in conformance with the Manual on Uniform Traffic Control Devices.

PROCEDURE AND METHODOLOGY

CHAPTER III

PROCEDURE AND METHODOLOGY

A. Field Investigation and Data Collection:

In order to properly evaluate all of the contributing factors involved at each location, an extensive on-site field survey was performed. Specific data obtained for each site included field measurements of sight distance, pavement width, vertical and horizontal alignment, signing and 24-hour automatic traffic counts. Peak hour turning movement counts were performed at those sites that included major intersections. Other work performed included mapping and photographing each site, locating and identifying obstructions, and observing driver characteristics and the quality of travel through each site. All study locations were also visited during evening hours to better evaluate deficiencies directly related to evening driving conditions.

Historical traffic data in the form of adjusted average daily traffic counts was available from the Department of Highways for several sites. Twenty-four hour automatic traffic counts were taken at all other locations, and were adjusted by applying factors for hourly, daily and monthly variations to represent the average daily traffic.

All reported accidents occurring from January, 1978 through December, 1980 were identified by site, and all pertinent accident was data obtained from the Montana Department of Justice. The Montana Highway Patrol accident reports were then analyzed and summarized for each site on accident data forms and composite collision diagrams.

Two field technicians visited each site and independently rated the road conditions with respect to driver expectancy and information system deficiencies. The technicians were not familiar with the detailed historical accident data in order to avoid unconsciously overrating any particular site.

B. Analysis of Data and Calculation of Hazard Indices:

A hazardous index was calculated for each site based on the following seven indicator values:

1. Number of Accidents
2. Accident Rate
3. Accident Severity
4. Volume/Capacity Ratio
5. Sight Distance
6. Driver Expectancy
7. Information System Deficiences

For each indicator, a value between 0 and 100 was calculated, with 0 representing no hazard and 100 representing the most hazardous. The indicator values were then weighted and totalled according to accepted Department of Justice methods and values outlined in DCA Project No. 79-04-01-01 to yield the Hazard Index.

The improvement costs for each site were calculated using current construction costs and weighted against the accident reduction benefits associated with the type of improvement. In addition to the cost/benefit ratio, a cost factor was determined. The cost factor represents the improvement costs per vehicle computed by dividing the total cost for improvements at a site by the number of vehicles entering that location over a period of five years. A five-year period is used because that is the average service life of the recommended short-term improvements. The form used to compute the cost factor is shown in Figure A2 in the Appendix.

The final phase in the analysis was to determine the Priority Index (P.I.). The Priority Index is the weighted average of the Hazard Index (H.I.) and the Cost Factor (C.F.), as shown in the following equation:

$$P.I. = 0.75\ (H.I.) + 0.25\ (C.F.)$$

The site improvements were then ranked according to priority based on the Accident Hazard Indicators, Non-Accident Hazard Indicators, Cost/Benefit Ratios, Hazard Index, and Priority Index.

The following section contains a brief explanation of each of the Hazard Indicators and the Cost/Benefit Ratio.

1. Number of Accidents:

Accident records for a three-year period from January, 1977 through December, 1980 were obtained from the Montana Highway Patrol. This accident data was then used to determine the three "accident" indicators (number of accidents, accident rate and accident severity). The annual average number of accidents occurring at each site was used to calculate this indicator value. Figure A3 in the Appendix shows the relationship between the annual number of accidents and the indicator value.

2. Accident Rate:

This indicator is used to compensate for the wide range of traffic volumes found throughout the study sites. The average daily traffic entering each site was calculated and adjusted to represent a three-year volume. The total number of accidents per million vehicles entering the site was then calculated, resulting in the accident rate. This figure was entered into Figure A4 in the Appendix to yield the corresponding indicator value.

3. Accident Severity:

This indicator evaluates the severity of the accidents occurring at each site in terms of dollars. A "Relative Severity Index" (Table A1 of the Appendix) was used to rate each accident according to accident type and to assign a corresponding accident cost. The R.S.I. values used are those in-

cluded in DCA Project No. 79-04-01-01. The average of the R.S.I. values at each site was calculated and entered into Figure A5 in the Appendix to determine the appropriate indicator value.

4. Volume-to-Capacity Ratio:

The individual characteristics of the sites vary greatly. This indicator value normalizes each site with respect to lane width, geometrics, traffic mix and volume. The capacity of each site was calculated for Service Level C in accordance with the Highway Research Board, Special Report 87, Highway Capacity Manual. The volume used represents the average daily traffic entering the site. The equation used to compute the index is as follows:

$$\frac{V}{C} = \frac{\text{ADT}}{24\ (\text{Capacity})}$$

This ratio was entered into Figure A6 (found in the Appendix) to yield the corresponding indicator value.

5. Sight Distance:

The sight distance at a particular site is an excellent indicator of the hazardousness of that location. Critical sight distances were measured at each location based on the criteria outlined in the DCA Project No. 79-04-01-01. The desirable sight distances for each particular location were then calculated according to the AASHO Manual Geometric Design of Rural Highways. For each case, the ratio of the existing versus the desirable Sight Distance was calculated. The two worst cases at each site were evaluated and a weighted average was computed by assigning a weight of two to the worst rating and one to the other rating. This weighted average sight distance ratio entered into Figure A7 (found in the Appendix) yields the corresponding indicator value.

6. Driver Expectancy:

The driver expectancy indicator is a purely subjective method of evaluating the ability of the average motorist to negotiate a particular section of roadway or intersection. Each site approach was rated using the criteria included on the driver expectancy form shown on Figure A8 in the Appendix. Each site was evaluated individually by two technicians and the ratings were averaged. The two approaches with the worst ratings were used in the calculation of the indicator value. A weighted average of the two ratings was calculated according to DCA weighting methods and used in Figure A9 of the Appendix to compute the corresponding indicator value.

7. Information System Deficiencies:

Similar to the driver expectancy ratings, this indicator is based on the subjective judgment of the evaluator. This rating consists of evaluating the signing and striping systems at each site with respect to the systems' ability to inform and guide the motorist through a particular section of road or in-

tersection. The actual criteria used in this evaluation are shown on the rating form (Figure A10) found in the Appendix.

All site approaches were independently rated by two technicians and their ratings averaged. Only the two worst average approach ratings were actually used to calculate this indicator. A weighted average of the two ratings was computed according to the weighting formula outlined in DCA Project 79-04-01-01. This weighted average was entered into Figure A11 in the Appendix to yield the appropriate indicator value.

8. Cost-Benefit Ratio:

Each site was analyzed and improvements were recommended. The improvement costs were estimated based on current Department of Highways statewide average construction costs. Although it is likely that Flathead County will implement some of the improvements with County forces, the "contracted" construction costs were used throughout for comparison purposes.

The benefits of each improvement were calculated based on the anticipated accident reduction resulting from that particular improvement. The Montana Department of Highways method for calculating the cost/benefit ratio was used and the computation format is shown in Figure A12 of the Appendix. A ranking of each site based on the cost/benefit ratio was compiled and is presented in Table 4. The site improvement yielding the greatest accident reduction benefit per dollar spent was given the highest ranking.

SITE ANALYSIS

IV

SITE 1

SITE NUMBER 1

AIR FORCE ROAD, LAKESIDE

A. Location:

Site 1 is located approximately .3 miles south of the intersection of Air Force Road and U.S. 93 at Lakeside. This site is located in a developing residential area near Flathead Lake.

B. Existing Conditions:

Air Force Road has an unstriped asphalt pavement width of approximately 18 feet with a three-foot gravelled shoulder. The grade on the north approach is approximately one percent leading into a relatively flat corner, while the west approach is relatively flat for several hundred feet leading into the corner. Curve warning signs as shown in Figure 1A are located on both approaches, but there is no posted speed limit sign along either approach. Plate 1 depicts the existing site conditions.

The 1981 ADT was determined to be 299 vehicles per day based upon 24-hour machine counts. The majority of this traffic is generated by area residents transporting refuse to a solid waste container site located further west along Air Force Road. As a result of the development of the Tamarack Woods Subdivision, a major access to the development will be located at the existing 90-degree corner, creating a "T" intersection. Developers of the subdivision estimate that an additional 468 vehicles per day may be added to the traffic on Air Force Road in the near future.

A large cluster of evergreen trees which are growing on the inside of the curve severely limit sight distance around the corner. In general, obstructions are located more than six feet from the edge of the roadway. Ten lots in the subdivisions have driveway accesses directly onto the west approach to the corner, and two of these lots are located within 200 feet of the corner. This fact, coupled with limited sight distance around the corner, presents a potentially hazardous situation.

C. Accident History:

There were two reported accidents at this location during the three-year study period. Both were single-vehicle, nighttime accidents. One accident occurred when the vehicle left the road and struck a fixed object, resulting in an injury. Both accidents occurred on the north approach to the curve on Air Force Road. This location has an accident rate of 6.5 accidents per million vehicles entering (M.V.E.).

D. Recommendations:

This 90-degree bend in the road connects two long, relatively flat tangent sections. It is important to effectively identify this situation for the motorist well in advance, especially at night. Sight distance is very limited

on the curve approaches which is compounded by the new accesses planned on the west approach. The Tamarack Woods development will increase the traffic on this section of road from approximately 300 to over 750 vehicles per day.

The following improvements are recommended: (See Figure 1B)

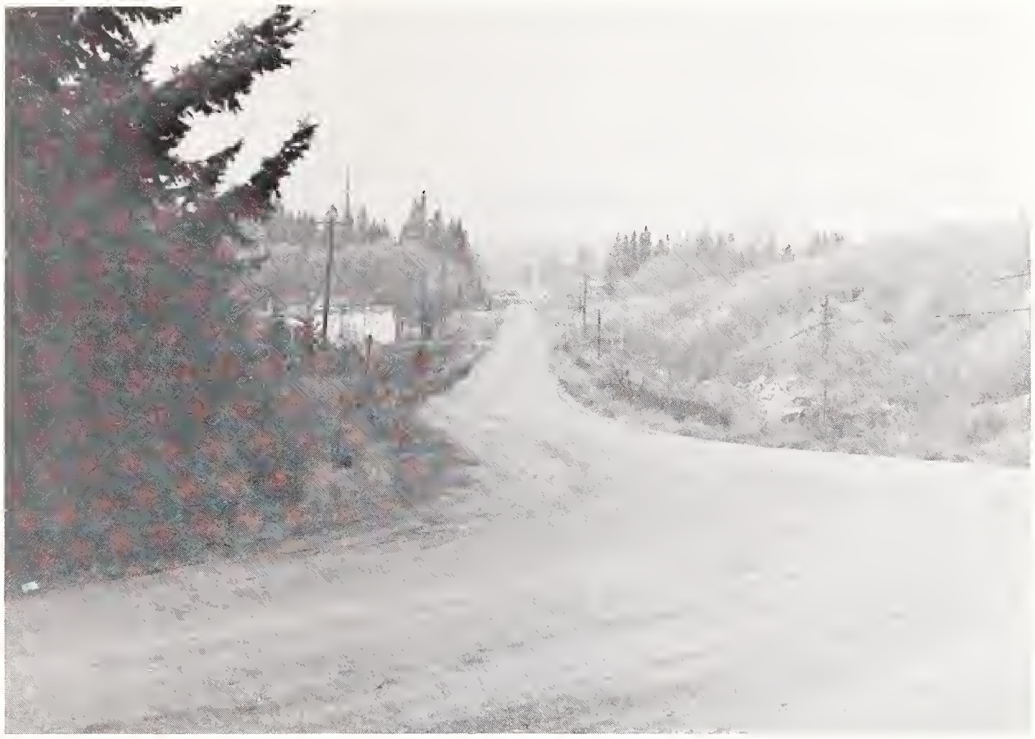
1. Install a double solid centerline stripe on the curve and both approaches back 500 feet.
2. Clear and grub all visual obstructions on the inside of the curve and back 200 feet from the curve on both approaches as shown on Figure 1B, removing approximately 25 six-inch diameter pine trees.
3. Place directional arrows (W1-6) on outside of the curve that can be clearly seen for 500 feet on each approach.
4. Relocate both existing warning signs (W1-1) 750 feet from the curve. Install 15 mph advisory speed plates (W13-1) with each curve warning sign. According to the AASHO design standard, the design speed for this curve is approximately 14 mph. This curve was traveled by a vehicle equipped with a ball bank indicator, and the safe speed was determined to be 15 mph.
5. Relocate the power pole on the inside on the curve 30 feet from the edge of the road.
6. It is recommended that in the future during the subdivision review process, driveway access locations be chosen carefully. If possible, common access should be utilized to serve two adjacent lots, thereby reducing the number of access points. Accesses along sections of road that have sight distance limitations are considered undesirable with respect to traffic safety, and should be avoided.

Improvement Cost Estimate

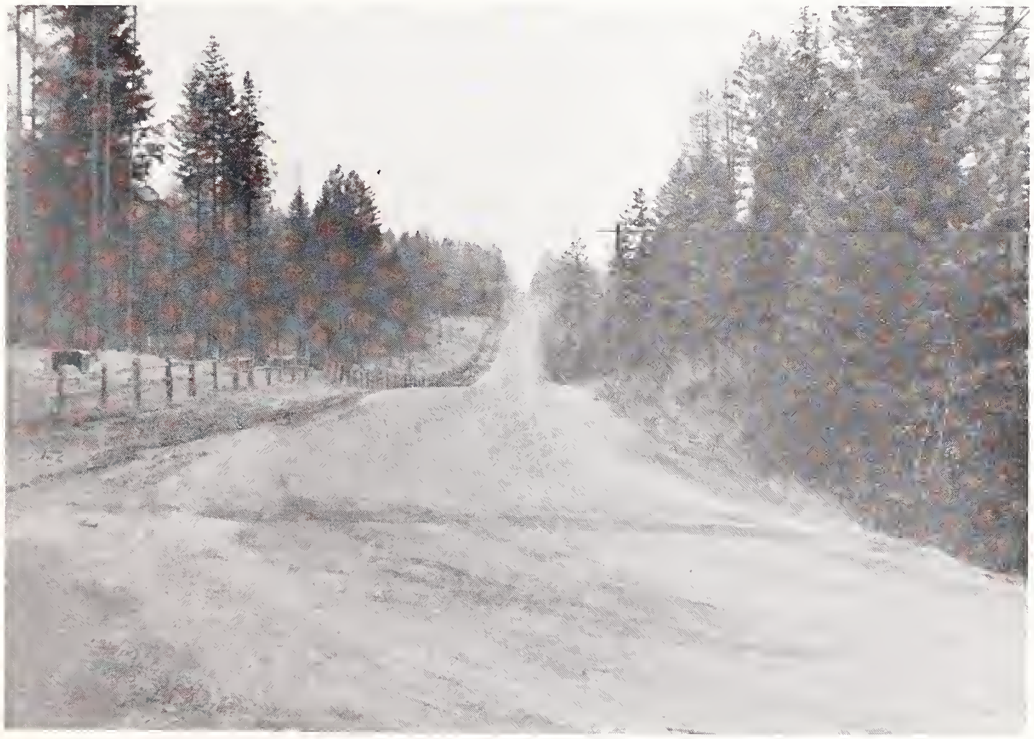
Quantity	Unit	Item Description	Unit Price	Total Price
2400	lf	4" Wide Solid Paint Striping	$0.04/lf	$ 96.00
½	ac	Clear and Grub	$2,000/ac	1,000.00
2	ea	Place Directional Arrow ((W1-6), 48" x 24"	$163/ea	326.00
2	ea	Remove and Relocate Curve Warning Sign (W1-1)	$60/ea	120.00
2	ea	Install 15 mph Advisory Speed Plate (W13-1)	$50/ea	100.00

TOTAL COST: $1,642.00

BENEFIT/COST RATIO: 2.94



North approach to Air Force Road as viewed from the curve. Note trees on left blocking sight distance around curve.



West approach as seen from the curve. Note Tamarack Woods subdivision on left.

ACCIDENT DATA

AIR FORCE ROAD, LAKESIDE

SITE NUMBER 1

ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
1	1	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1		1				

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
								1			1

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
																			1			1	

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Daylight	Dark	Dawn	Dusk
	2		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
1			1	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
2			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Sideswipe	Non-Col	Head-on	Backing
			1				1		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
			1				1	

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	0	1	0
Fatality	0	0	0
Property Dam. Only	1	0	0

DETERMINATION OF HAZARD INDEX

Site Number 1 Date November, 1981

Site Description Air Force Road, Lakeside

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	0.7 acc/yr	21	x 0.164 =	3.44
Accident Rate	6.5 acc/MVE	80	x 0.225 =	18.00
Accident Severity	11,450 dollars	67	x 0.191 =	12.80
Volume/Capacity Ratio	0.07	22	x 0.082 =	1.80
Sight Distance Ratio	0.83 (wt. avg.)	48	x 0.074 =	3.55
Driver Expectancy	2.0 (wt. avg.)	33	x 0.149 =	4.92
Information System Deficiencies	4.0 (wt. avg.)	67	x 0.115 =	7.71

Hazard Index: 52.22

Cost of Recommended Improvements: $1,642.00

Cost Factor: 94

Priority Index = Hazard Index x .75 + Cost Factor x .25

52.22 x .75 + 94 x .25 = 62.67

EXISTING CONDITIONS & COLLISION DIAGRAM

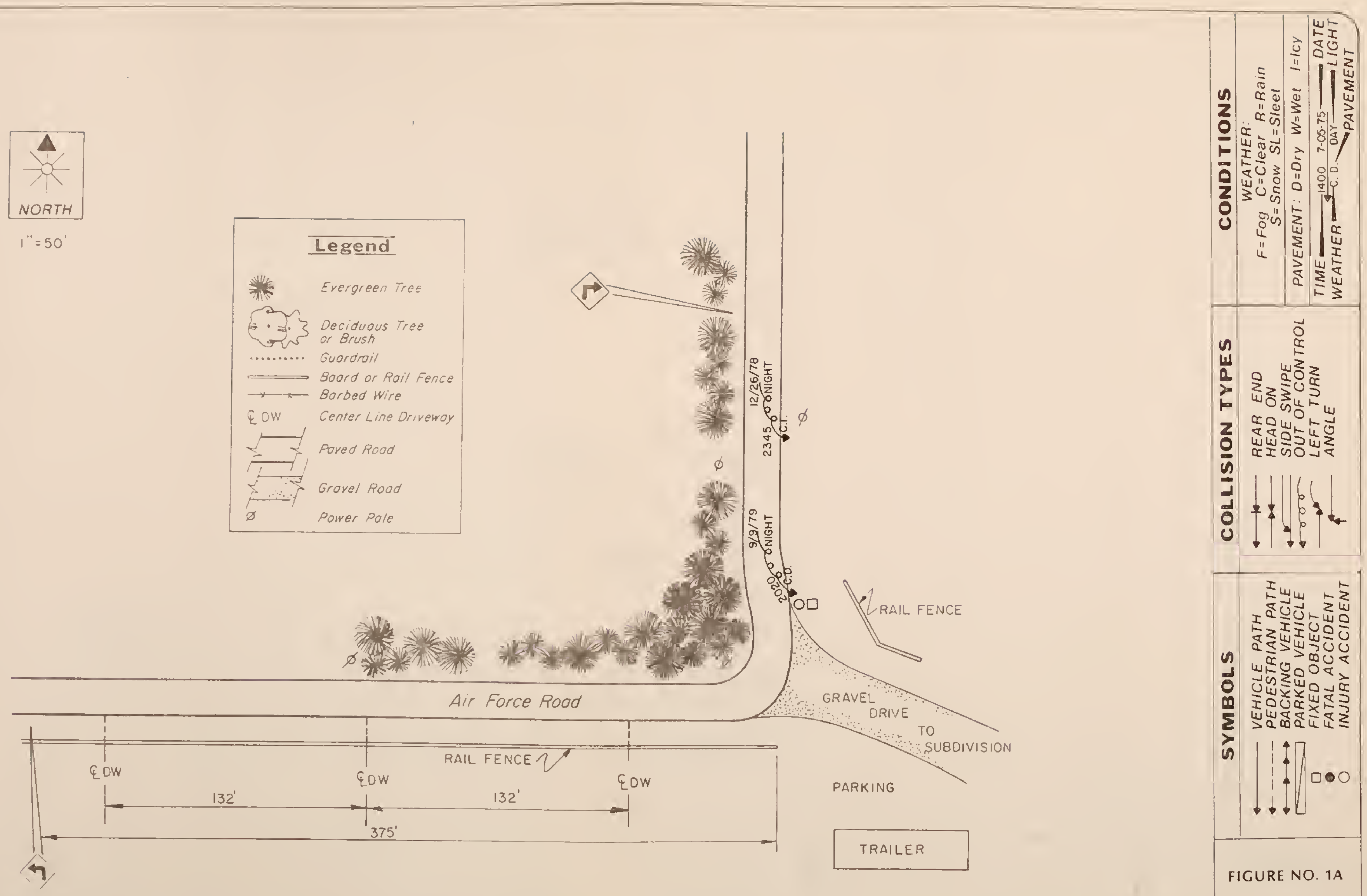
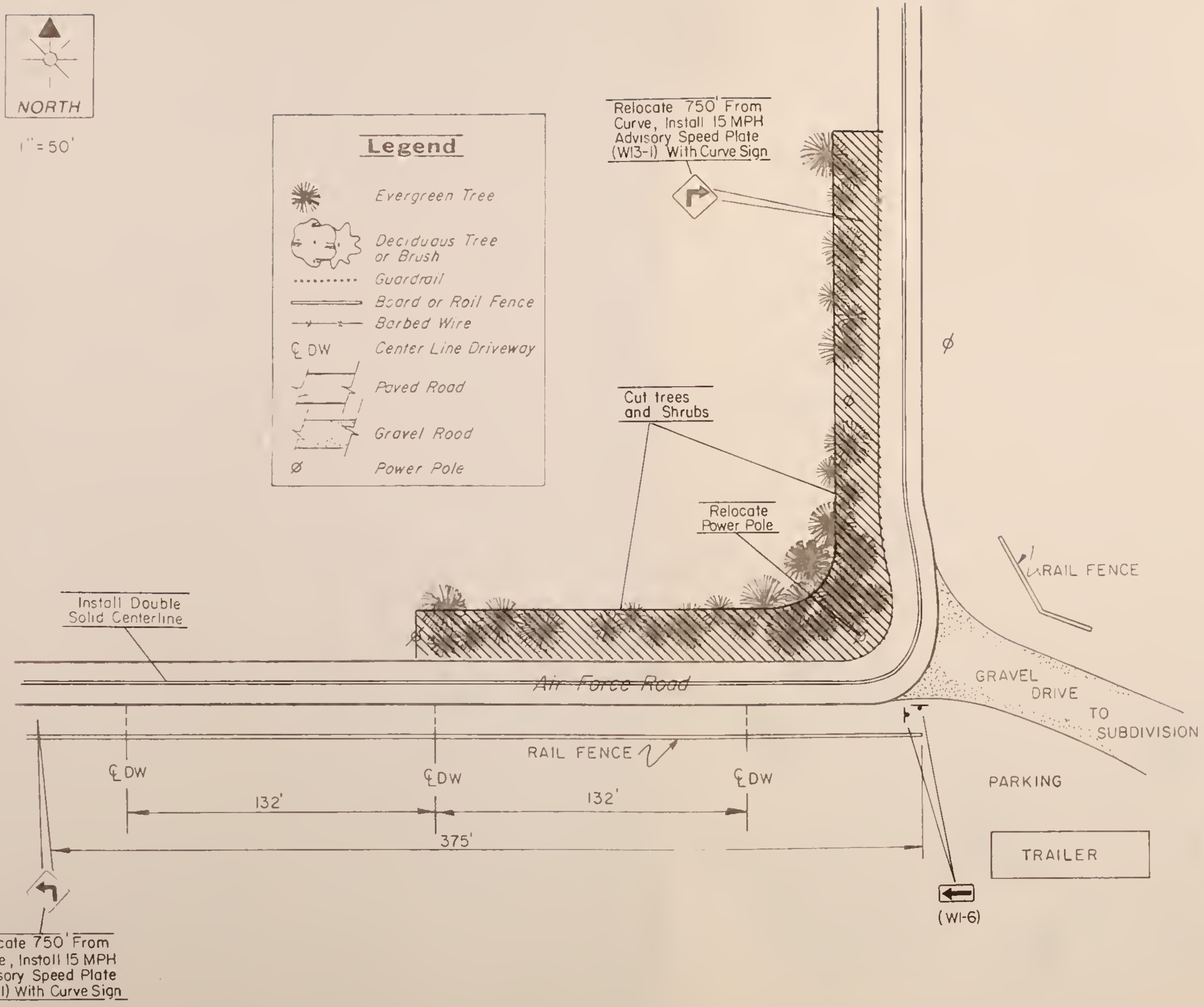


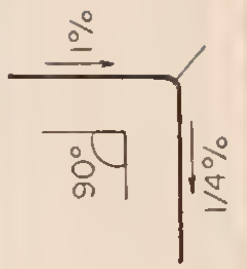
FIGURE NO. 1A

Air Force Road, Lakeside

RECOMMENDED IMPROVEMENTS


NORTH
1" = 50'
Legend
Evergreen Tree
Deciduous Tree or Brush
Guardrail
Board or Rail Fence
Barbed Wire
℄ DW Center Line Driveway
Paved Road
Gravel Road
Ø Power Pole
Relocate 750' From Curve, Install 15 MPH Advisory Speed Plate (W13-1) With Curve Sign
Cut trees and Shrubs
Relocate Power Pole
Install Double Solid Centerline
Air Force Road
RAIL FENCE
GRAVEL DRIVE TO SUBDIVISION
PARKING
TRAILER
RAIL FENCE
℄ DW
℄ DW
℄ DW
132'
132'
375'
(W1-6)
Relocate 750' From Curve, Install 15 MPH Advisory Speed Plate (W13-1) With Curve Sign

EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

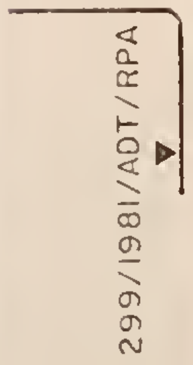


FIGURE NO. 1B

Air Force Road,
Lakeside

SITE 2

SITE NUMBER 2

INTERSECTION OF MONTANA 35 (FAP 52), HOLT ROAD, AND ELECTRIC AVENUE, BIG FORK

A. Location:

Site 2 is the intersection of Montana 35, Holt Road, and Electric Avenue at Big Fork. The site is located within a rapidly developing residential and commercial area near Flathead Lake.

B. Existing Conditions:

All major roadways at the intersection are surfaced with asphalt pavement. Montana 35 (north-south approach) is typically 48 feet wide and has turning lanes, medians, and shoulders delineated with pavement striping. Grades on Montana 35 vary from 3.5 to 4.5 percent through the section. Electric Avenue is 56 feet wide from the roadway edge to a painted median. A 22-foot wide right-turn bay is also located on the east approach. Electric Avenue is relatively flat and has a double solid centerline stripe. Holt Road (west approach) is a 21-foot-wide roadway, quite flat, and with no pavement striping. The alignment of Electric Avenue and Holt Road is offset approximately 40 feet. In addition to these approaches, a driveway access to the Big Fork Ranger Station intersects with Montana 35 at the site. The 25-foot-wide asphalt surfaced roadway has a seven percent grade. Two access roads join Holt Road at the intersection. Access to Lakeside Subdivision is provided by an 18-foot-wide asphalt surfaced roadway with an 8.5 percent grade. Access to the North Shore Lanes bowling alley is provided by a 16-foot-wide gravel surfaced road. The road grade at the intersection is approximately five percent. The intersection is depicted in Figure 2A, which details existing sight conditions.

In addition to pavement striping, other traffic control devices have been placed at the intersection. Stop signs have been placed on all approaches and accesses except Montana 35; however, the stop sign on the west approach is partially hidden by roadside vegetation. Painted stop bars are located on Electric Avenue, and a pedestrian crossing is located across the south approach to the intersection. Pedestrian crossing warning signs are located well in advance on both the north and south approaches. Overhead intersection warning lights have also been installed at the site. Flashing amber lights are visible from the north and south approaches, and flashing red lights are visible from the east and west approaches to the intersection. The posted speed limit for Montana 35 is 45 mph through the section, while the speed limits on Electric Avenue and Holt Road are 25 and 35 mph, respectively. Metal guard rail and reflectors are used to delineate the edge of the roadway on Montana 35. Photographs contained in Plates 2A and 2B depict these site conditions.

Machine counts of 24-hour traffic volumes and peak hour turning move-

ments were conducted for all major approaches to the intersection by the Montana Department of Highways and Robert Peccia and Associates. Based on this data, it was determined that the 1981 ADTs for Montana 35 were 3,315 and 3,137 vehicles per day for the north and south approaches, respectively. Electric Road was determined to have a 1981 ADT of 2,170 vehicles per day. Average daily traffic for Holt Road was determined to be 531 vehicles per day.

C. Accident History:

The accident history for this site goes beyond the three-year period. The pre-1978 annual accident rate was approximately four accidents per year. In 1978, the Department of Highways made several improvements which have resulted in a reduction in accidents. Since the improvements, accidents are occurring at the rate of two per year. During the three-year study period from 1978 through 1980, six accidents were reported, with four of the six accidents occurring at night. The accident rate for this location is 1.4 accidents per million vehicles entering.

D. Recommendations:

The basic problem with this intersection is the vast amount of area it encompasses, compounded by the existence of six approaches. The long-term solution to the problem is to reconstruct the intersection to a more standard channelized configuration. This is addressed as a long-term improvement.

The short-term improvements are listed as follows:

1. Install crossroad warning signs (W2-1) on the north and south approaches. The signs should be located 800 feet from the intersection.
2. Install stop ahead signs (W3-1) 300 feet from the intersection on the east and west approaches.
3. A lane designation sign (R3-8) should be installed on the north approach 250 feet from the intersection.
4. The existing striping and signing in the vicinity of this intersection should be maintained so as to provide the greatest visibility to the motorist.
5. The stop sign on the west approach should be relocated as close as possible to the intersection without interfering with the bowling alley entrance.
6. Install a stop bar and centerline striping on the west approach. The stop bar should be placed approximately 30 feet from the intersection.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
2	ea	Install Crossroad Warning Sign (W2-1)	$130/ea	$260.00
2	ea	Install Stop Ahead Warning Sign (R3-1)	$130/ea	260.00
1	ea	Relocate Stop Sign	$60/ea	60.00
1	ea	Install Lane Designation Sign (R3-8), 30" x 30"	$130/ea	130.00
1	ea	Install Stop Bar and Centerline Striping	Lump Sum	50.00
TOTAL COST:				$760.00

BENEFIT/COST RATIO: 0.91

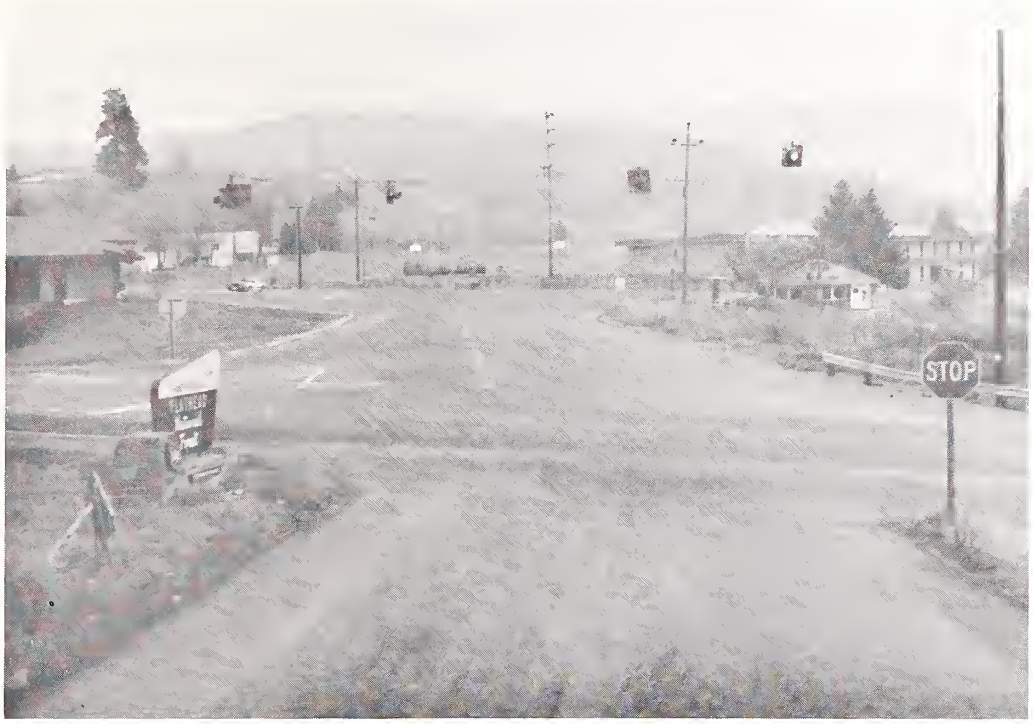
Long-term Improvements:

The realignment of this intersection would solve several of the built-in problems at this location. The reconstruction of this intersection would require that the Forest Service access be relocated to the west on Holt Road. It would also require the realignment of Holt Road 40 feet to the north. The Montana Department of Highways has been in contact with the Forest Service, and it is understood that the Forest Service has agreed to relocate their entrance. As part of this realignment, the access to the subdivision should be closed off. Presently, there are three accesses to this subdivision. This particular access location is not used extensively during the winter due to the road grade. The access to the bowling alley should be moved 50 feet to the west on Holt Road. The approach from the east could be narrowed by shifting the guard rail on the southeast corner 15 feet to the north. The existing painted median island on the east approach should be changed to a raised median, and the stop sign should be relocated with respect to this median. In addition, a yield sign should be installed for the right-turn bay. The stop sign on the west approach should be relocated to an appropriate location on the realigned approach (see Figure 2C).

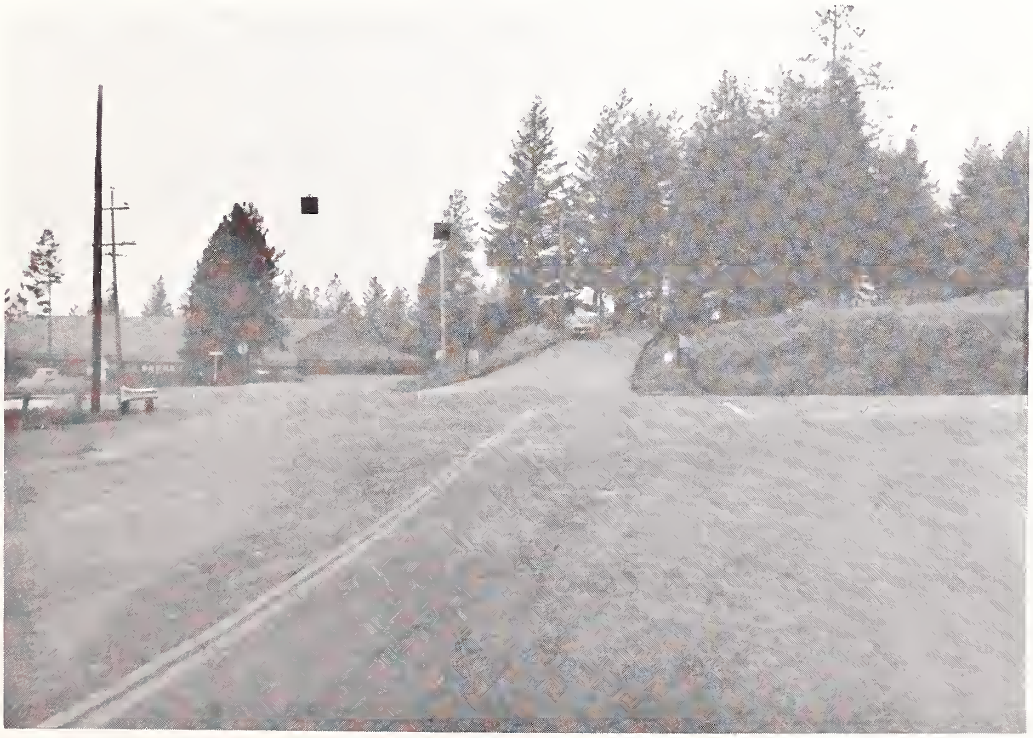
Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
750	cy	Excavation	$6/cy	$4,500.00
200	lf	New Guard Rail	$10/lf	2,000.00
200	lf	Relocate Existing Guard Rail	$10/lf	2,000.00
1000	sy	Asphalt Pavement, 3" Full Depth	$6/sy	6,000.00
200	sy	Scarify Road Bed	$2/sy	400.00
1	ea	Median	Lump Sum	2,000.00
1	ea	Misc. Sign Relocation	Lump Sum	1,000.00
1	ea	Restripe Intersection Approaches	Lump Sum	2,000.00
1	ea	Relocate Crosswalk	Lump Sum	700.00
TOTAL LONG-TERM IMPROVEMENT COST:				* $20,600.00

* Does not include right-of-way acquisition costs



View to the east from the Forest Service approach. Note alignment of Electric Avenue across the intersection.



View of the intersection from the east approach on Electric Avenue. Note offset alignment of Holt Road across the intersection to the left.

ACCIDENT DATA

INTERSECTION OF MONTANA 35 (FAP 53), HOLT ROAD, AND ELECTRIC AVENUE, BIG FORK

SITE NUMBER 2 *ACCIDENT PERIOD* 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
2	4	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
	2		1	1	2	

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
	2					1	2			1	

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
											1						1	3			1		

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	*Dark*	*Dawn*	*Dusk*
2	4		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
4			1	1

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
5		1	

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Side-swipe*	*Non-Col*	*Head-on*	*Backing*
2		1	1				2		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

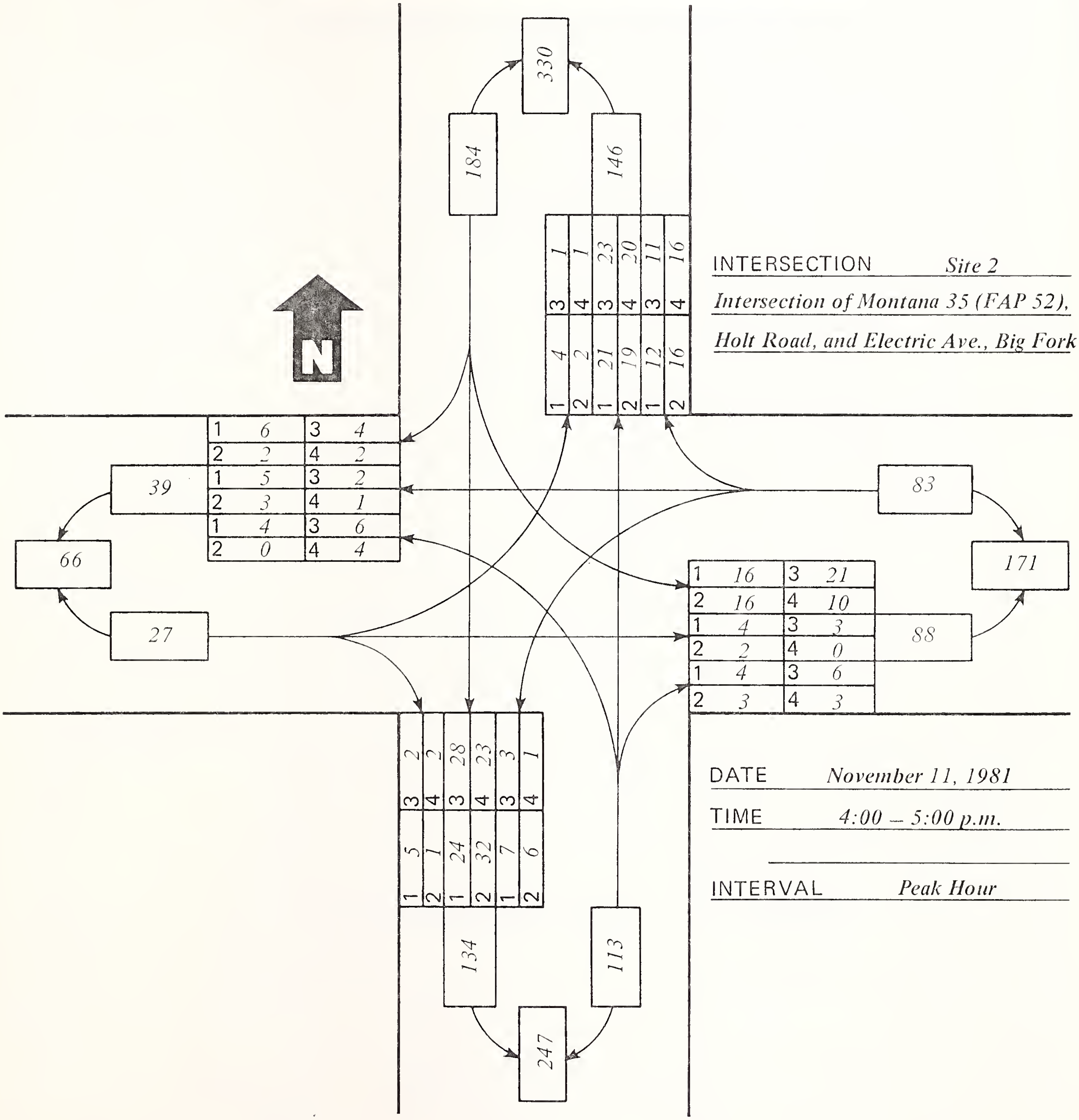
No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
1	2		2				1	

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	2	1	0
Fatality	0	0	0
Property Dam. Only	0	3	0

Robert Peccia & Associates

TURNING MOVEMENTS



INTERSECTION *Site 2*

Intersection of Montana 35 (FAP 52),

Holt Road, and Electric Ave., Big Fork

DATE *November 11, 1981*

TIME *4:00 – 5:00 p.m.*

INTERVAL *Peak Hour*

RPA Robert Peccia & Associates

DETERMINATION OF HAZARD INDEX

Site Number 2 Date November, 1981

Site Description Intersection of Montana 35 (FAP 52), Holt Road, and Electric Avenue, Big Fork

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	2.0 acc/yr	37	x 0.164 =	6.07
Accident Rate	1.4 acc/MVE	24	x 0.225 =	5.40
Accident Severity	15,383 dollars	76	x 0.191 =	14.52
Volume/Capacity Ratio	0.04	16	x 0.082 =	1.31
Sight Distance Ratio	0.98 (wt. avg.)	33	x 0.074 =	2.44
Driver Expectancy	4.5 (wt. avg.)	75	x 0.149 =	11.18
Information System Deficiencies	5.7 (wt. avg.)	94	x 0.115 =	10.81

Hazard Index: 51.73

Cost of Recommended Improvements: $760.00

Cost Factor: 100

Priority Index = Hazard Index x .75 + Cost Factor x .25

51.73 x .75 + 100 x .25 = 63.80

EXISTING CONDITIONS & COLLISION DIAGRAM

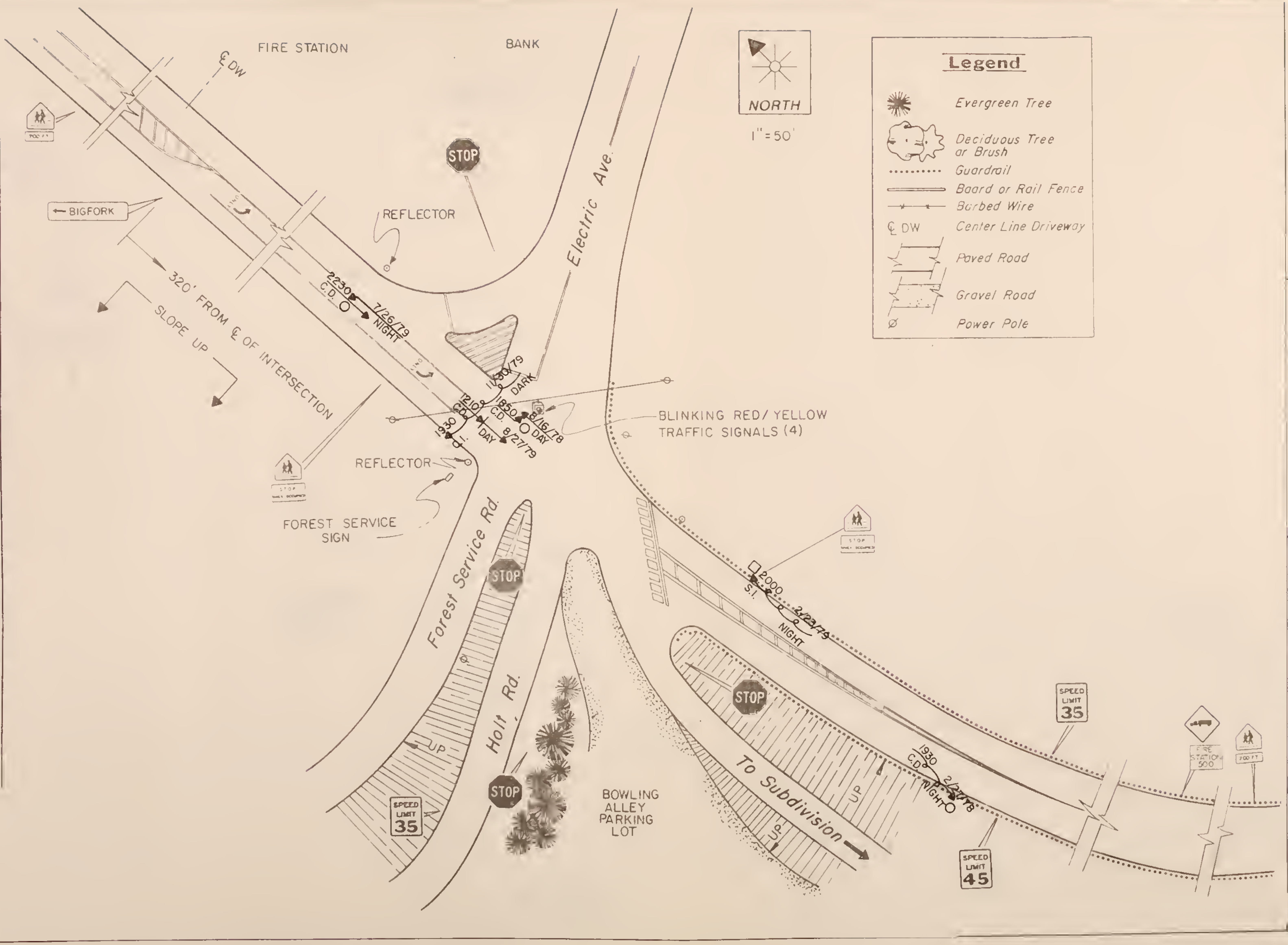
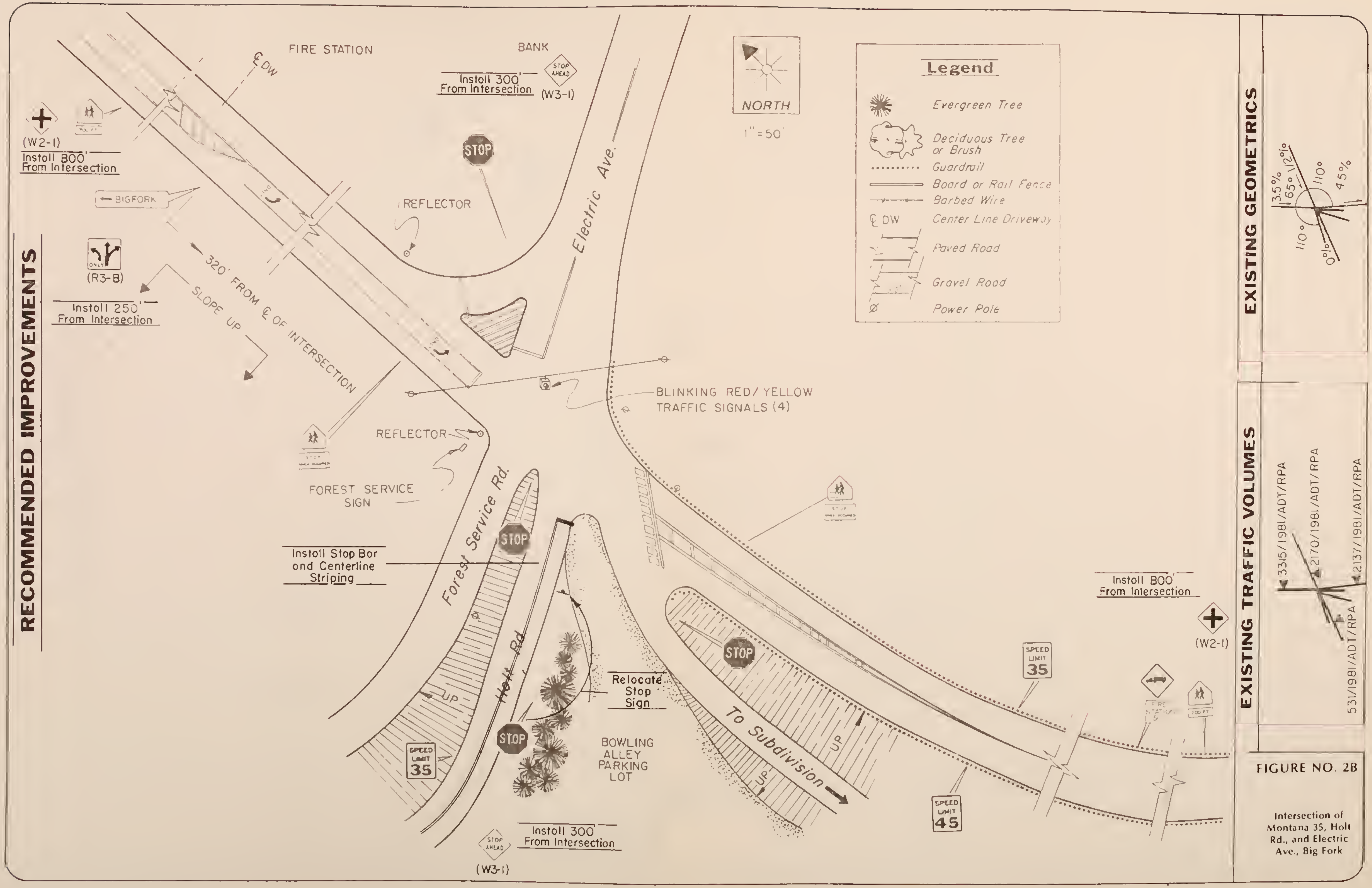


FIGURE NO. 2A

Intersection of Montana 35, Holt Rd., and Electric Ave., Big Fork



RECOMMENDED IMPROVEMENTS

EXISTING GEOMETRICS

EXISTING TRAFFIC VOLUMES

FIGURE NO. 2B

Intersection of Montana 35, Holt Rd., and Electric Ave., Big Fork

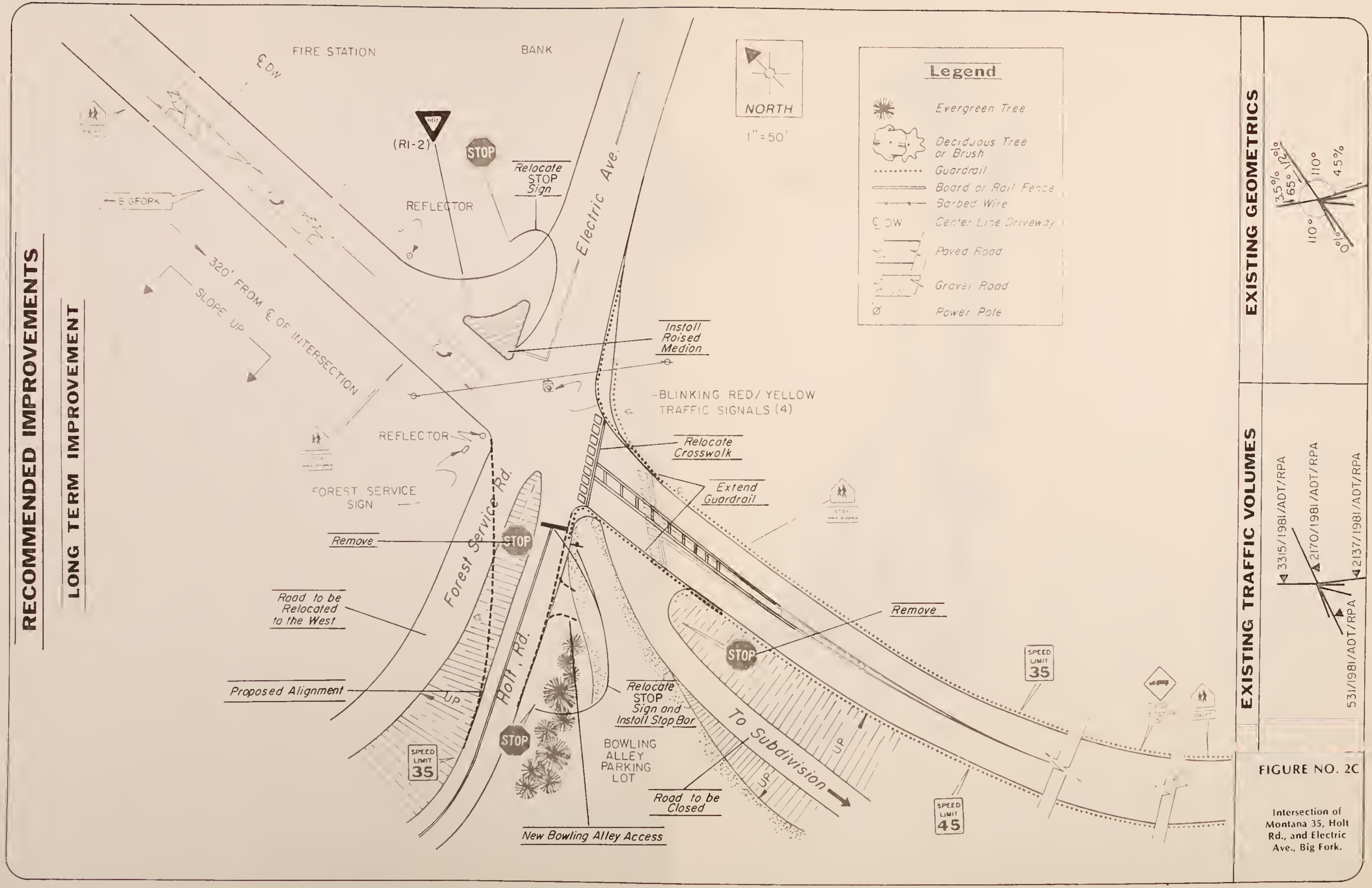


FIGURE NO. 2C

Intersection of Montana 35, Holt Rd., and Electric Ave., Big Fork.

S
I
T
E
3

SITE NUMBER 3

BOON ROAD, SOMERS

A. Location:

Site 3 includes a quarter-mile section of Boon Road approximately .6 miles from its intersection with U.S. 93 at Somers.

B. Existing Conditions:

The gravelled roadway surface at this site varies in width from 16 to 21 feet. The road winds through a heavily wooded area with maximum grades of 5.5 percent through the eastern portion of the study section. There is no signing on this section of road, and the sight distance is limited through all curves by the vegetation and the upslope bank of the road cuts. Trees are located within four feet of the roadway at numerous locations throughout the site, and also constitute obstructions to sight distance. Based on 24-hour traffic counts, the 1981 ADT is estimated to be 50 vehicles per day. It is expected that this road receives the greatest traffic volumes during the summer months. Figure 3A and Plate 3 depict existing site conditions.

C. Accident History:

Three accidents were reported for this section of Boon Road, two at night and one at dawn. All three occurred as a result of drinking or reckless driving. Two of the accidents occurred when the motorist lost control of the vehicle on a curve, left the road and struck a tree, and both accidents resulted in injuries. Because of the low volume of traffic, the site accident rate is 38.9 accidents per million vehicles entering (M.V.E.).

D. Recommendations: (See Figure 3B)

This site has no signing and poor sight distance. The sight distance limitations are due to the road alignment and the trees near the edge of the travel way. These trees also compound the risk of injury-type accidents.

The following improvements are recommended:

1. All trees on the outside of the curve should be removed on the south side of Boon Road as shown on Figure 3B.
2. All right-of-way should be cleared and grubbed back to the fence on the north side of Boon Road.
3. Curve warning signs (W1-1) should be placed 300 feet from the curve on both approaches. Although a distance of 500 feet would be more desirable, it was felt that due to the alignment, a greater setback distance would be less effective. 15 mph advisory speed plates (W13-1) should accompany the curve warning signs. The safe speed for this curve was determined by the use of a ball bank indicator.
4. Reflectorized delineators (Design "C") should be placed on the south side of the road as shown on Figure 3B.

5. Directional arrows (W1-6) should be placed in the curve so that they will be clearly visible for 300 feet on each approach.

6. The east approach should be widened slightly, as shown on Figure 3B. This widening will improve the alignment on the curve approach.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
½	ac	Clear and Grub	$2,000/ac	$1,000.00
2	ea	Install Curve Warning Sign (W1-1)	$130/ea	260.00
2	ea	Install Advisory Speed Plate (W13-1)	$50/ea	100.00
2	ea	Install Directional Arrow (W1-6), 48" x 24"	$163/ea	326.00
6	ea	Install Reflectorized Delineator, 4" x 4", Design "F"	$15.50/ea	93.00
6	ea	Install Reflectorized Delineator, 4" x 4", Design "C"	$18/ea	108.00
50	cy	Crushed Gravel	$8/cy	400.00
TOTAL COST:				$2,287.00

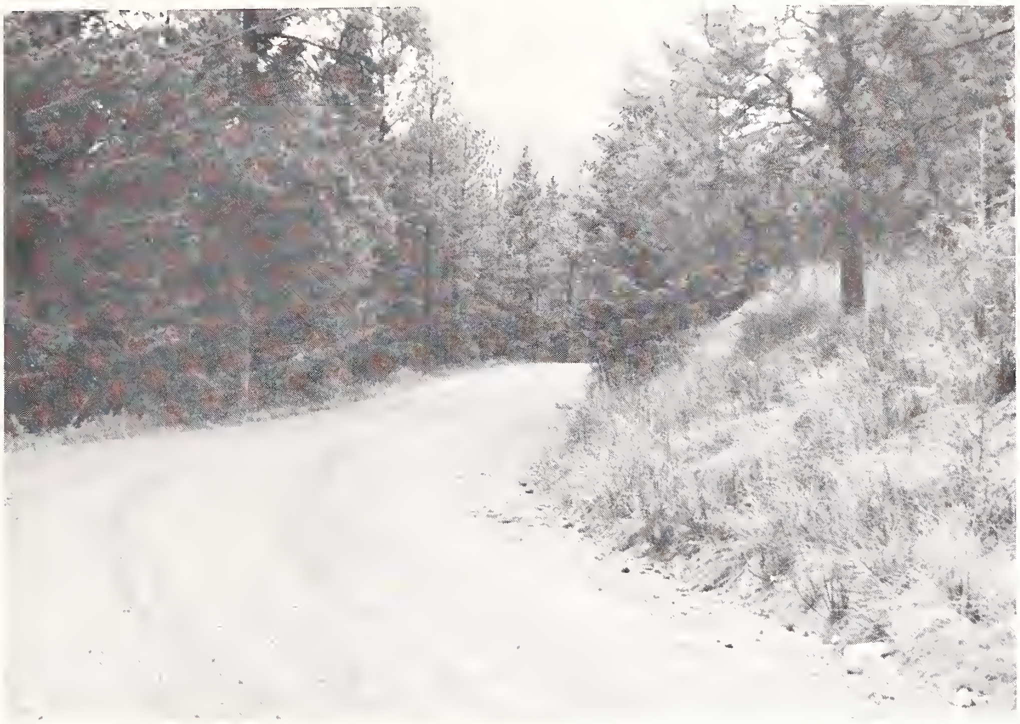
BENEFIT/COST RATIO: 7.35

Long-Term Improvements:

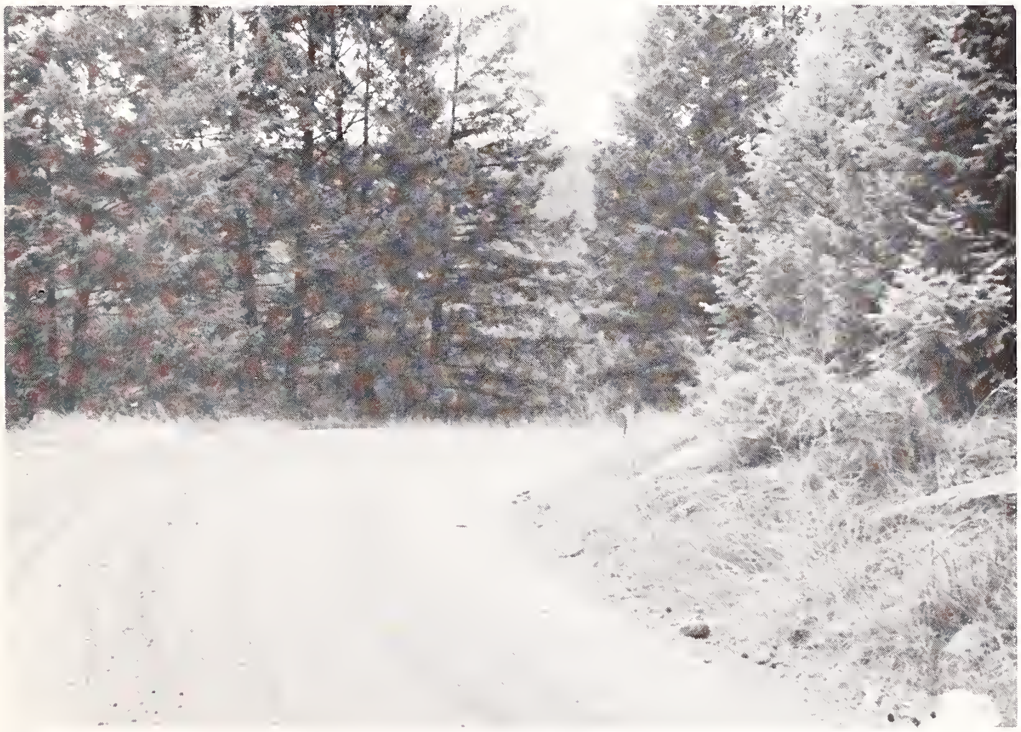
The upsloping bank on the inside of the curve should be cut to a steeper grade (1:1 maximum). The excavated material (approximately 400 cubic yards) should be deposited on the outside of the curve in order to flatten the slope (6:1 optimum).

Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
400	cy	Excavation and Embankment	$5/cy	$2,000.00
TOTAL LONG-TERM IMPROVEMENT COST:				$2,000.00



West approach as viewed from the curve in Boon Road. Note proximity of trees to the edge of the roadway.



Same curve as seen from the east approach. Note trees and shrubs on the inside of the curve limiting sight distance.

ACCIDENT DATA

BOON ROAD, SOMERS

SITE NUMBER 3 ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
3	0	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
2					1	

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
							1	1			1

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1			1		1																		

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
	2	1	

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
2	1			

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
3			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
			2					1	

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
	1	2						

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	2	0	0
Fatality	0	0	0
Property Dam. Only	1	0	0

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DETERMINATION OF HAZARD INDEX

Site Number 3 Date November, 1981

Site Description Boon Road, Somers

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	1.0 acc/yr	27	x 0.164 =	4.43
Accident Rate	38.9 acc/MVE	100	x 0.225 =	22.50
Accident Severity	14,800 dollars	74	x 0.191 =	14.13
Volume/Capacity Ratio	0.02	10	x 0.082 =	0.82
Sight Distance Ratio	0.83 (wt. avg.)	48	x 0.074 =	3.55
Driver Expectancy	5.0 (wt. avg.)	83	x 0.149 =	12.37
Information System Deficiencies	6.0 (wt. avg.)	100	x 0.115 =	11.50

Hazard Index: 69.30

Cost of Recommended Improvements: $2,287.00

Cost Factor: 50

Priority Index = Hazard Index x .75 + Cost Factor x .25

69.30 x .75 + 50 x .25 = 64.48

EXISTING CONDITIONS & COLLISION DIAGRAM

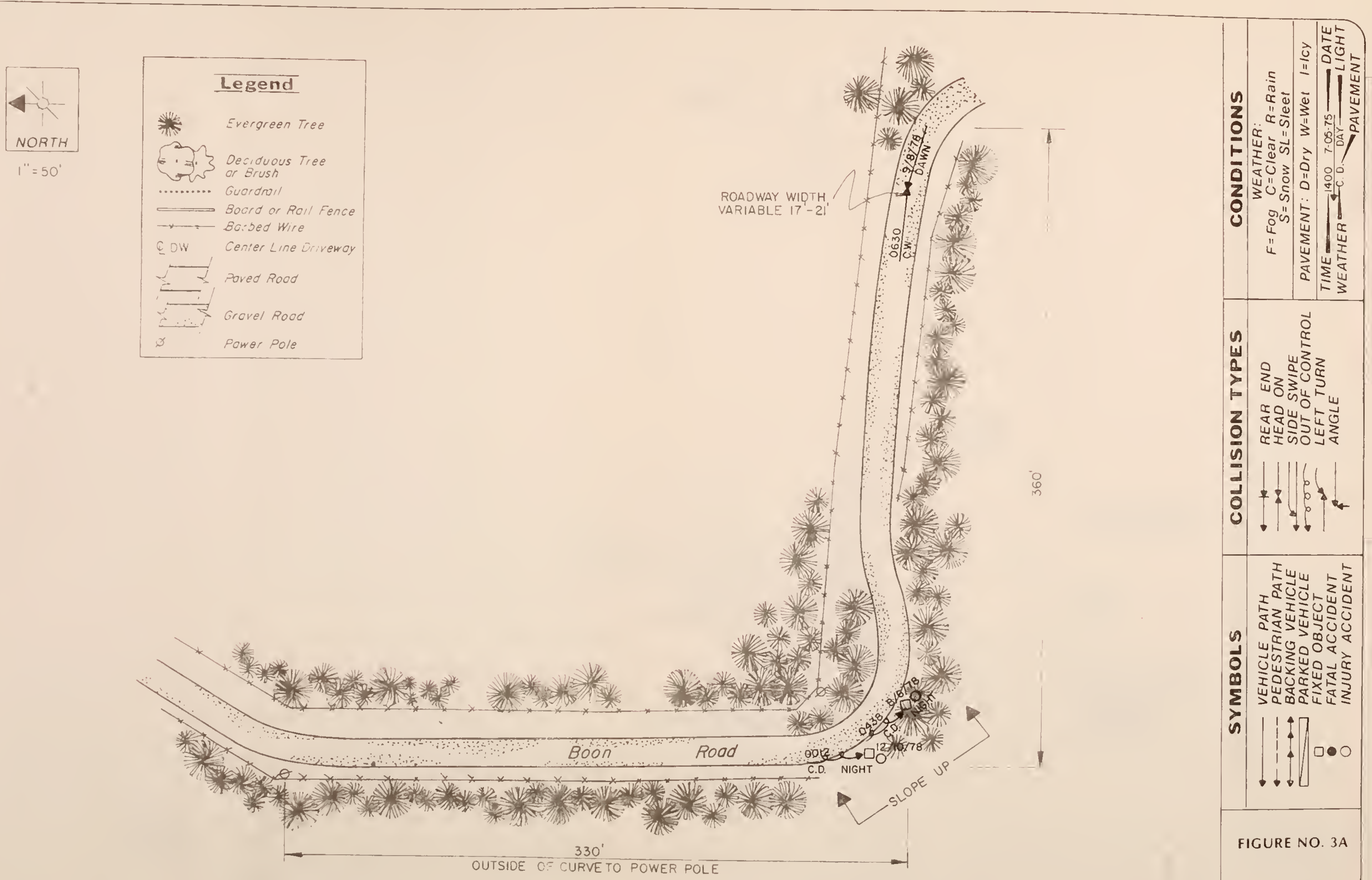
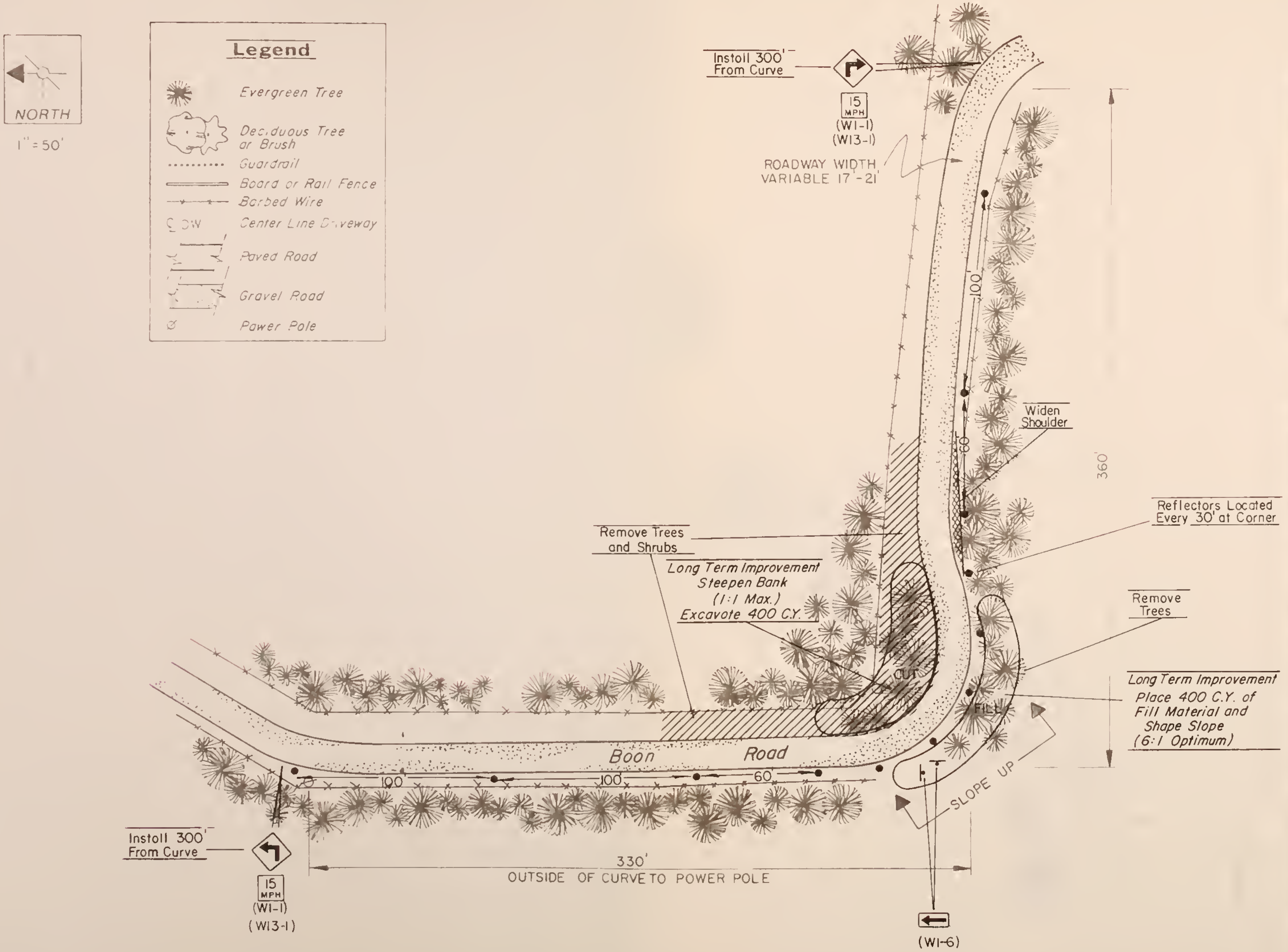


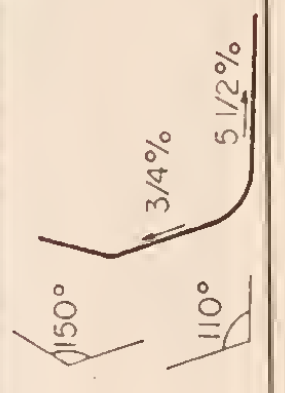
FIGURE NO. 3A

Boon Road,
Somers

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

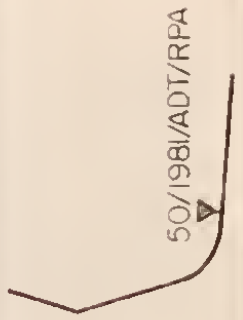


FIGURE NO. 3B

Boon Road,
Somers

SITE 4

SITE NUMBER 4

FOYS CANYON ROAD (FAS 503)

A. Location:

Site 4 is located about four miles south of Kalispell and includes Foys Canyon Road (FAS 503) and Patrick Creek Road. The site is located approximately 1.3 miles from the intersection of Airport Road (FAS 503) and Rocky Cliff Drive.

B. Existing Conditions:

Foys Canyon Road and Patrick Creek Road are both gravel surfaced and are typically 18 feet wide. Grades at the intersection are uniform and flat; however, the Patrick Creek leg quickly assumes a 6.5 percent grade and Foys Canyon Road a 4.8 percent grade to the east of the intersection. There are no speed limit signs or curve warning signs within the site. Several rock outcrops, trees, utility poles, road cuts and fences are located within six feet of the roadway and constitute obstructions. Sight distances are severely restricted by two of the rock outcrops at the roadway edge. Figure 4A and Plate 4 depict these site conditions.

Based upon Montana Department of Highways traffic counts, the 1981 ADT was determined to be 245 vehicles per day. Traffic on this section of roadway is partially the result of logging activities in the Patrick Creek area and recreation activities at Foys Lake and Lone Pine State Park located several miles away. Foys Canyon Road is also a public school bus route.

C. Accident History:

There was only one accident reported at this location in the three-year period. Local residents recall approximately four accidents (obviously unreported) during the same period of time; however, only reported accidents were used for the accident analysis. The predominant problems are limited sight distance combined with a narrow travel way. It appears that low-speed head-on collisions and sideswipe-type accidents do occur on this section of road. This site has an accident rate of 4.0 accidents per million vehicles entering (M.V.E.).

D. Recommendations:

Due to the fact that there is limited right-of-way on the north side of the road and acquisition possibilities are poor, the improvements are concentrated on the south side.

The following improvements are recommended:

1. Cut all trees and shrubs within six feet of the edge of the roadway, and prune any branches that would block site distance.
2. Widen the roadway to a uniform width of 20 feet.

3. Excavate and remove rock outcroppings (approximately 200 c.y.) on the south side of road. The toe of the rock slope should be a minimum of four feet from the edge of the road.

4. Place "Y" intersection warning signs (W2-5) 300 feet from the intersection on all of the approaches.

5. Place a yield sign (R1-2) on the southwest approach to the intersection.

6. The existing "Logging Truck" sign is not a standard sign. Although this sign may be appropriate, the use of unorthodox signs is not recommended. When the existing sign reaches the end of its service life, it is recommended that the sign be removed and not replaced.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
20	ea	Cut Trees 6" Max. Dia.	$25/ea	$ 500.00
5	ea	Cut Trees 12" Min. Dia.	$120/ea	600.00
200	cy	Rock Excavation and Removal	$8/cy	1,600.00
3	ea	Install "Y" Intersection Warning Sign (W2-5)	$130/ea	390.00
1	ea	Install Yield Sign (R1-2) 36" x 36" x 36"	$165/ea	165.00
50	ea	Common Excavation for Road Widening	$4/cy	200.00
50	cy	Crushed Gravel	$8/cy	400.00
TOTAL COST:				$3,855.00

BENEFIT/COST RATIO: 0.23

Long-Term Improvements:

The rock outcroppings on the south side of the road should be excavated back so that the toe of the rock slope is a minimum of six feet from the edge of the roadway.

Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
1400	cy	Rock Excavation and Removal	$8/cy	$11,200.00
TOTAL LONG-TERM IMPROVEMENT COST:				$11,200.00

View of Foys Canyon Road from the "Y" intersection looking east. Note road width, which varies in places from 16 to 19 feet.

View of curve from east approach. Note limited sight distance around bend.

ACCIDENT DATA

FOYS CANYON ROAD (FAS 503)

SITE NUMBER 4 ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
1	0	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
						1

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
		1									

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
													1										

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
1			

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
			1	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
1			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
								1	

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
			1					

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	0	0	0
Fatality	0	0	0
Property Dam. Only	1	0	0

DETERMINATION OF HAZARD INDEX

Site Number 4 Date November, 1981

Site Description Foys Canyon Road (FAS 503)

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	0.3 acc/yr	13	x 0.164 =	2.13
Accident Rate	4.0 acc/MVE	58	x 0.225 =	13.05
Accident Severity	19,600 dollars	83	x 0.191 =	15.85
Volume/Capacity Ratio	0.22	39	x 0.082 =	3.20
Sight Distance Ratio	0.83 (wt. avg.)	48	x 0.074 =	3.55
Driver Expectancy	4.3 (wt. avg.)	72	x 0.149 =	10.73
Information System Deficiencies	5.0 (wt. avg.)	83	x 0.115 =	9.55

Hazard Index: 58.06

Cost of Recommended Improvements: $3,855.00

Cost Factor: 82

Priority Index = Hazard Index x .75 + Cost Factor x .25

58.06 x .75 + 82 x .25 = 64.05

EXISTING CONDITIONS & COLLISION DIAGRAM

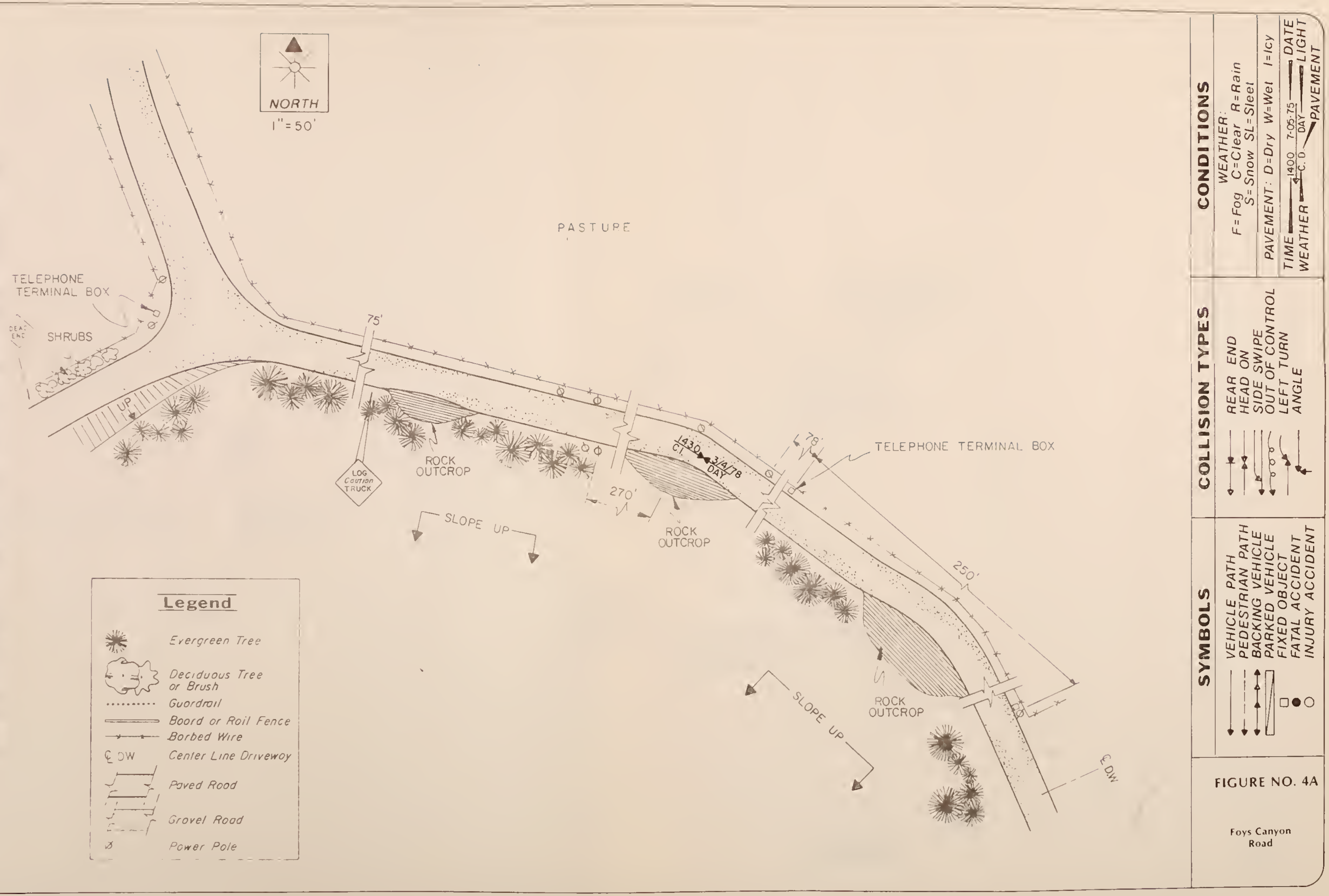
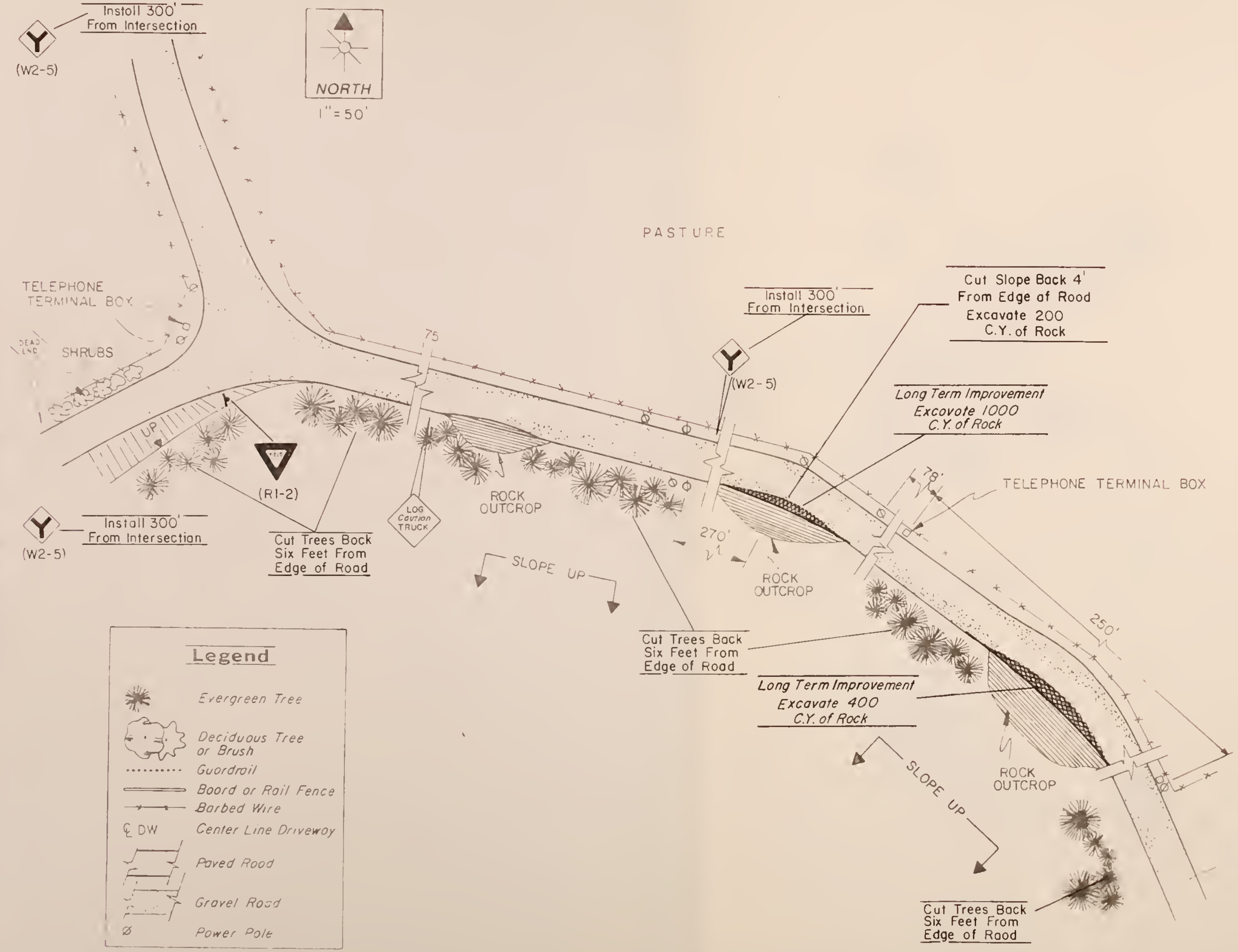


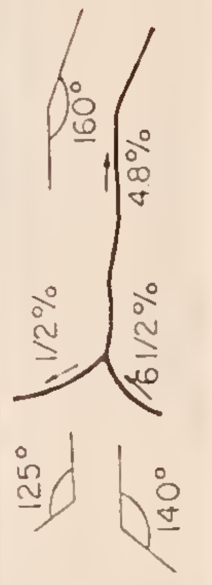
FIGURE NO. 4A

Foys Canyon Road

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

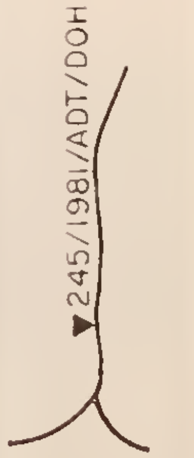


FIGURE NO. 4B

Foys Canyon Road

S
I
T
E
5

SITE NUMBER 5

INTERSECTION OF KILA ROAD AND SPRING HILL ROAD

A. Location:

Site 5 includes the "Y" intersection of Kila Road and Spring Hill Road. This site is located approximately nine road miles southwest of Kalispell in the community of Kila, .75 miles southeast of U.S. Highway 2.

B. Existing Conditions:

Both Kila Road and Spring Hill Road have asphalt pavement surfaces generally 22 feet wide which have been recently chip sealed. Grades on Kila Road are one percent from the Ashley Creek Bridge through the intersection, while Spring Hill Road climbs to the east at .5 percent from its intersection with Kila Road. The site has no pavement markings at the present time; however, several warning signs exist on the south (Kila Road) and east (Spring Hill Road) approaches. A "T" intersection warning sign with a 20 mph advisory speed plate is located about 400 feet southwest of the intersection. In addition, a directional arrow sign is located on the east side of the intersection and is visible to vehicles approaching from the southwest. It should be noted that a stop sign was formerly located on the south approach; however, it proved to be ineffective and was removed. A yield sign is located approximately 100 feet southeast of the intersection on Spring Hill Road. Sight distance is restricted on the southeast and southwest approaches by the intersection geometrics and the hilly terrain between the approaches. Existing site conditions are depicted in Figure 5A and on Plate 5.

Traffic on the road is primarily residential, although access to logging operations and to a State Fishing Access Site is provided by the roadways. Based upon 24-hour machine traffic counts conducted by Robert Peccia and Associates in November, 1981, the ADT was determined to be 680 vehicles per day at Ashley Creek Bridge and 460 vehicles per day on the southwest approach to the intersection.

C. Accident History:

There were no reported accidents at this site during the three-year study period.

D. Recommendations: (See Figure 5B)

The alignment of this intersection combined with the dominant flow of traffic indicate that preference should be given to the north and southwest approaches. Sight distance is obstructed by the mild upsloping ground on the south side of the intersection.

The following improvements are recommended:

1. Replace the "T" intersection warning sign (W2-4) on the southwest approach with a curve warning sign (W1-1). Due to the road alignment, the existing sign location appears optimum. The 20 mph advisory speed plate (W13-1) should be retained. A vehicle equipped with a ball bank indicator was used to determine that 20 mph is the safe speed for traveling through this curve.
2. Install a "Y" intersection warning sign (W2-5) on the southeast approach 750 feet back from the intersection.
3. Install two direction arrow signs (W1-7) on the east and south sides of the intersection so they are clearly visible for 750 feet back on the approach (see Figure 5B).
4. Install a double solid centerline stripe beginning 300 feet back from the intersection on the southwest approach and extending through the intersection to the south edge of the bridge.
5. Relocate the yield sign (R1-2) on the southeast approach closer to the intersection as shown in Figure 5B.
6. Install a curve warning sign (W1-1) with a 20 mph advisory speed plate 750 feet from the intersection on the north approach.
7. Relocate the double directional arrow (W1-7) from its present location on the east side of the intersection to the north side, as shown on Figure 5B.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
2	ea	Install Curve Warning Sign (W1-1) with 20 mph Advisory Speed Plate (W13-1)	$180/ea	$360.00
1	ea	Remove "T" Intersection Warning Sign (W2-4)	$35/ea	35.00
1	ea	Install "Y" Intersection Warning Sign (W2-5)	$130/ea	130.00
2	ea	Install Directional Arrow Sign (W1-6), 48" x 24"	$163/ea	326.00
1	ea	Relocate Double Directional Arrow Sign (W1-7)	$60/ea	60.00
1400	lf	Paint Striping - 4" Wide Solid	$0.04/lf	56.00
TOTAL COST:				$967.00

BENEFIT/COST RATIO: 0.00*

* There were no accidents at this site; therefore, the Benefit/Cost Ratio is zero.

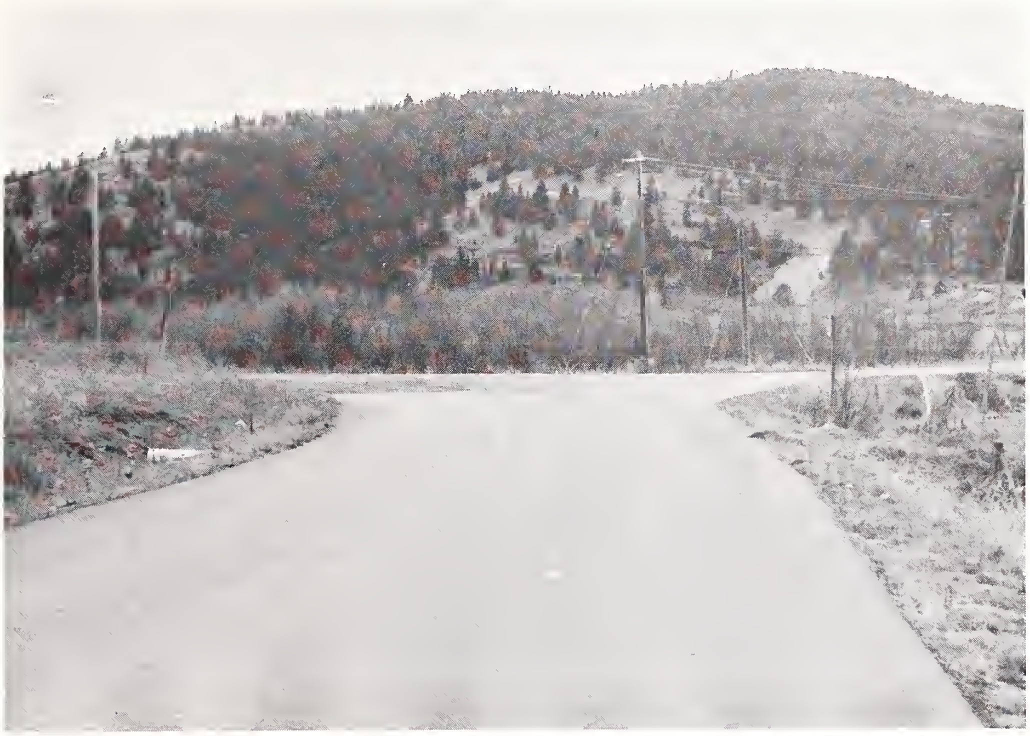
Long-Term Improvements:

It would be preferable to slope the bank on the south side of the intersection with the toe no closer than six feet from the edge of the roadway and at a slope of 1½:1. This would greatly improve the sight distance. In order to do this, it would be necessary to acquire permission to reslope approximately one-half acre of the private land to the south and remove and replace 450 feet of barbed wire fence. Approximately 1,000 cubic yards of excavation would be required.

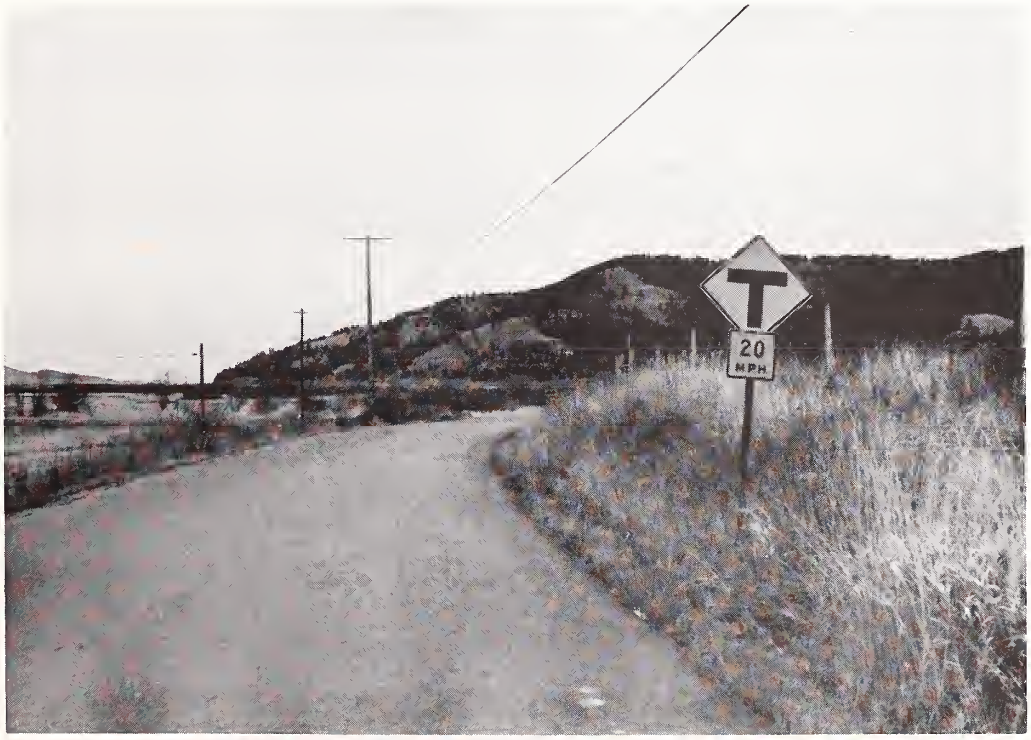
Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
1000	cy	Excavation	$6/cy	$6,000.00
450	lf	Remove and Replace Barbed Wire Fence	$2/lf	900.00
TOTAL LONG-TERM IMPROVEMENT COST:				* $6,900.00

* Does not include right-of-way or easement costs.



View of the "Y" intersection at Kila from the southeast approach. Note bank at left limiting view of the southwest approach.



View of the southwest approach to the Kila intersection. Note the "T" intersection warning sign, instead of a more appropriate "Y" intersection warning sign.

DETERMINATION OF HAZARD INDEX

Site Number 5 Date November, 1981

Site Description Intersection of Kila Road and Spring Hill Road

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	0 acc/yr	0	x 0.164 =	0
Accident Rate	0 acc/MVE	0	x 0.225 =	0
Accident Severity	0 dollars	0	x 0.191 =	0
Volume/Capacity Ratio	0.02	12	x 0.082 =	0.98
Sight Distance Ratio	0.69 (wt. avg.)	67	x 0.074 =	4.96
Driver Expectancy	3.7 (wt. avg.)	61	x 0.149 =	9.09
Information System Deficiencies	4.3 (wt. avg.)	72	x 0.115 =	8.28

Hazard Index: 23.31

Cost of Recommended Improvements: $967.00

Cost Factor: 100

Priority Index = Hazard Index x .75 + Cost Factor x .25

23.31 x .75 + 100 x .25 = 42.48

EXISTING CONDITIONS & COLLISION DIAGRAM

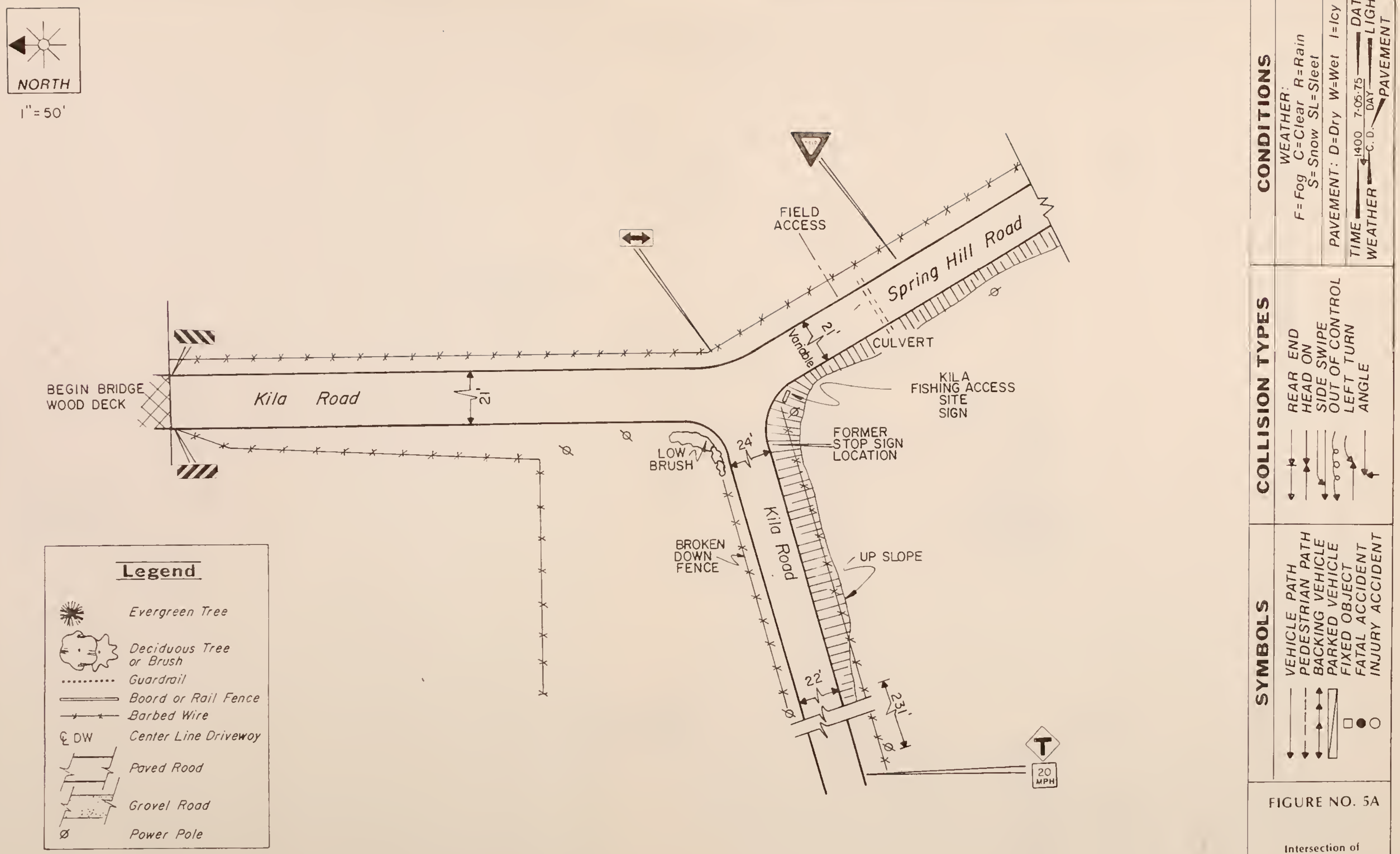
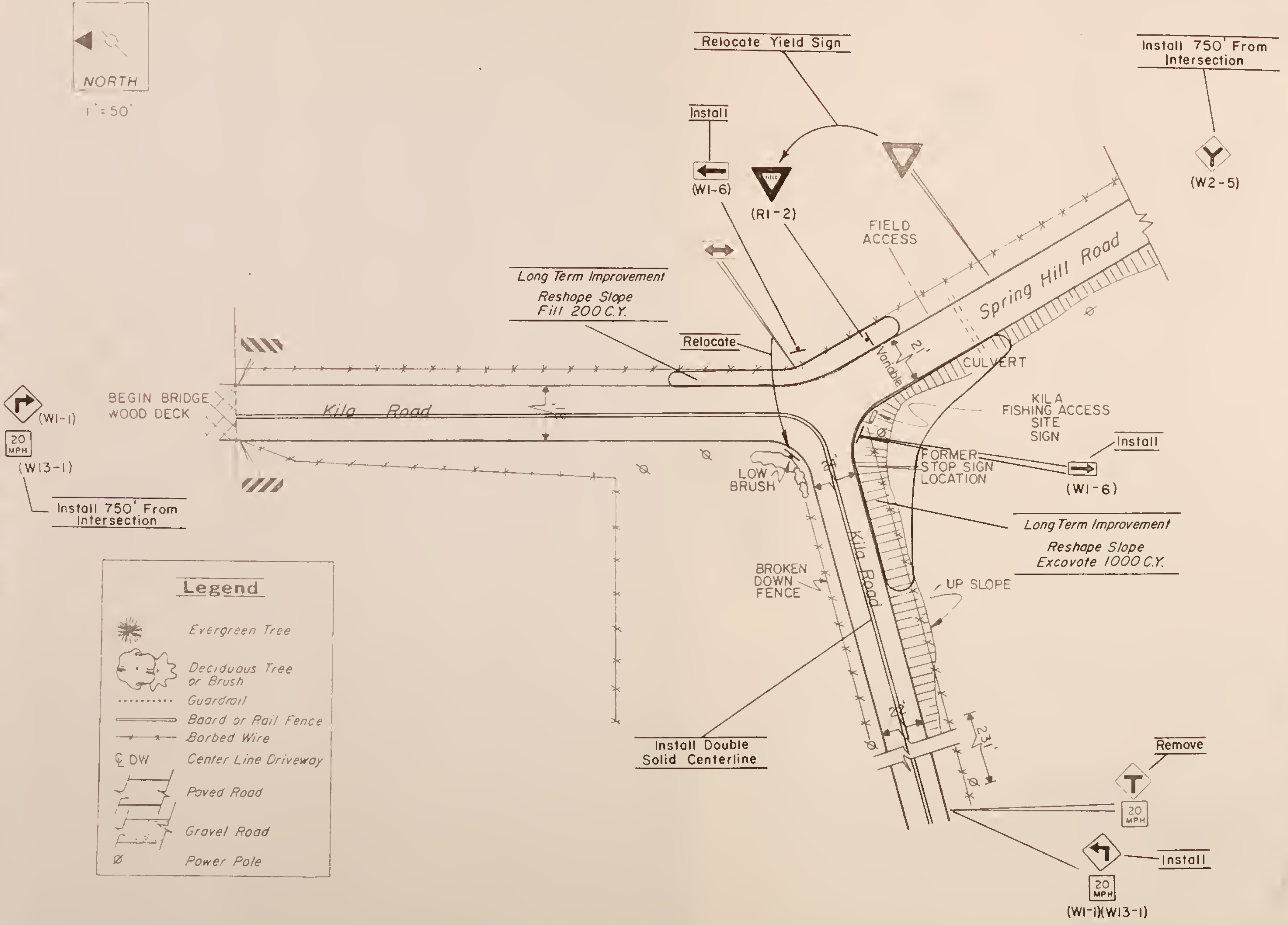


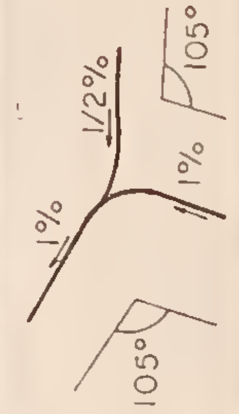
FIGURE NO. 5A

Intersection of
Kila Rd. and
Spring Hill Rd.

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

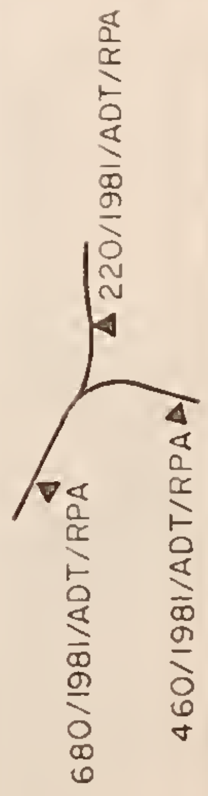


FIGURE NO. 5B

Intersection of Kila Rd. and Spring Hill Rd.

SITE 6

SITE NUMBER 6

INTERSECTION OF WILLOW GLEN DRIVE (FAS 317) AND WOODLAND AVENUE (FAU 6726)

A. Location:

Site 6 includes the 90-degree "T" intersection of Willow Glen Drive (FAS 317) and Woodland Avenue (FAU 6726) just southeast of the Kalispell city limits. Willow Glen Drive is often used by north-south traffic to bypass congestion in downtown Kalispell. Woodland Avenue connects Willow Glen Drive with most of the residential areas on Kalispell's east side.

B. Existing Conditions:

Both Willow Glen Drive and Woodland Avenue have asphalt pavements; Willow Glen Drive is typically 22 feet wide and Woodland Avenue is generally 24 feet wide. The eight percent grade on the north approach limits sight distance for drivers attempting to turn left from the south approach of Willow Glen Drive and to drivers wishing to turn north or south from Woodland Avenue. Grades on the west and south approaches do not exceed .5 percent. Approaches to the intersection are not striped; however, the intersection itself has centerline stripes and a painted median. Although this striping is effective, it is not in conformance with the Manual on Uniform Traffic Control Devices. The posted advisory speeds for Willow Glen Drive and Woodland Avenue are 35 mph and 25 mph, respectively. Signing includes "Dangerous Intersection, 500 Feet" and standard "T" intersection warning signs placed in advance of the intersection on the north and south approaches. Signing on the west approach to the intersection includes a stop sign and double directional arrow on the east side of the intersection depicting the change in traffic direction. In general, obstructions are greater than six feet from the edge of the roadway; however, the fence on the southwest corner of the intersection is located only three feet off the edge of the roadway. Willow Glen Drive is located on the extreme east side of the 60-foot right-of-way. These existing conditions are depicted in Figure 6A and by site photographs contained in Plates 6A and 6B.

Based upon 24-hour machine counts of traffic conducted by the Montana Department of Highways and peak hour turning movement counts conducted by Robert Peccia and Associates, the ADT for the west approach (Woodland Avenue) was determined to be 925 vehicles per day; the north and south approaches (Willow Glen Drive) had ADTs of 1,166 and 1,930 vehicles per day, respectively.

C. Accident History:

Six accidents were reported at this intersection during the three-year study period, and four of the six resulted in injuries. Although the majority of the accidents occurred during daylight hours, a study of the accidents reveals that the drivers cannot see the approaching traffic. In most

cases, a left turn made by a vehicle on the approach from the south results in an angle-type accident when struck by a southbound motorist. This intersection has an accident rate of 2.9 accident per million vehicles entering.

D. Recommendations:

The principal problem with this intersection is the sight distance limitations imposed by the vertical alignment of Willow Glen Drive. The only way to correct this problem is to lengthen the vertical curve alignment. In order to do this, it will be necessary to cut down the center of the intersection three feet and taper the cut back 150 feet on the north and south approaches and 200 feet back on the east approach.

The following short-term improvements are recommended:

1. Install a stop ahead warning sign (W3-1) on the west approach 500 feet back from the intersection.
2. Relocate the existing "T" intersection warning sign (W2-2) on the north approach 750 feet from the intersection. Install a similar "T" intersection sign on the south approach 750 feet from the intersection.
3. Cut all trees on the west side of the north approach back to the limits of the county right-of-way.
4. Install object marker signs (OM-3) on the ends of the guard rail.
5. Change the solid line pattern in the intersection to a dashed pattern. This change will allow for effective guidance of the motorist through a more conventional striping system.
6. Install a double solid centerline stripe on the north approach extending 750 feet from the intersection.
7. Relocate the existing 35 mph speed limit sign from its present location to a point approximately 400 feet south of the intersection.
8. Install reflectorized delineators on either side of the Woodland Avenue approach. The amber 4" x 8", Design "D" delineators should be used.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
18	ea	Cut Trees 6" Max. Dia.	$6/cy	$ 450.00
1	ea	Relocate "T" Intersection Approach Warning Sign (W2-2)	$60/ea	60.00
2	ea	Install "T" Intersection Approach Warning Sign (W2-2)	$130/ea	260.00
1	ea	Paint Removal	Lump Sum	100.00

Improvement Cost Estimate
(cont.)

Quantity	Unit	Item Description	Unit Price	Total Price
4	ea	Install Object Marker Sign (OM-3), 1' x 3', Yellow and Black	$140/ea	560.00
1	ea	Relocate Speed Limit Sign	$60/ea	60.00
2	ea	Install Reflectorized Delineators, 4"x8", Design "D"	$20/ea	40.00
1	ea	Paint 6" Wide Dashed Stripe and Stop Bar	Lump Sum	50.00
1,500	lf	Paint 4" Wide Solid Striping	$0.04/lf	60.00
TOTAL COST:				$1,640.00

BENEFIT/COST RATIO: 2.24

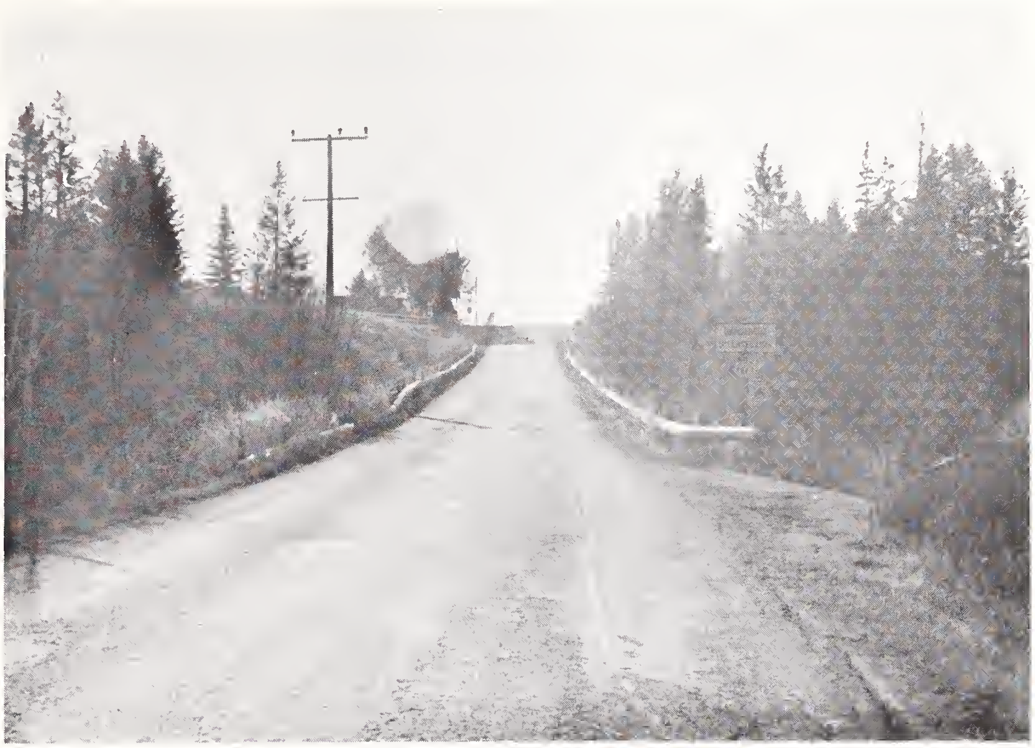
Long-Term Improvements:

Reconstruction of the intersection is considered to be the only way to alleviate the basic sight distance problems at this location. It is recommended to cut down the intersection by excavating approximately 800 cubic yards of material and to reconstruct the intersection with essentially the same horizontal alignment. The southeast corner should be reshaped as shown on Figure 6B. The recommended profile is also shown in this figure. No right-of-way acquisition is required.

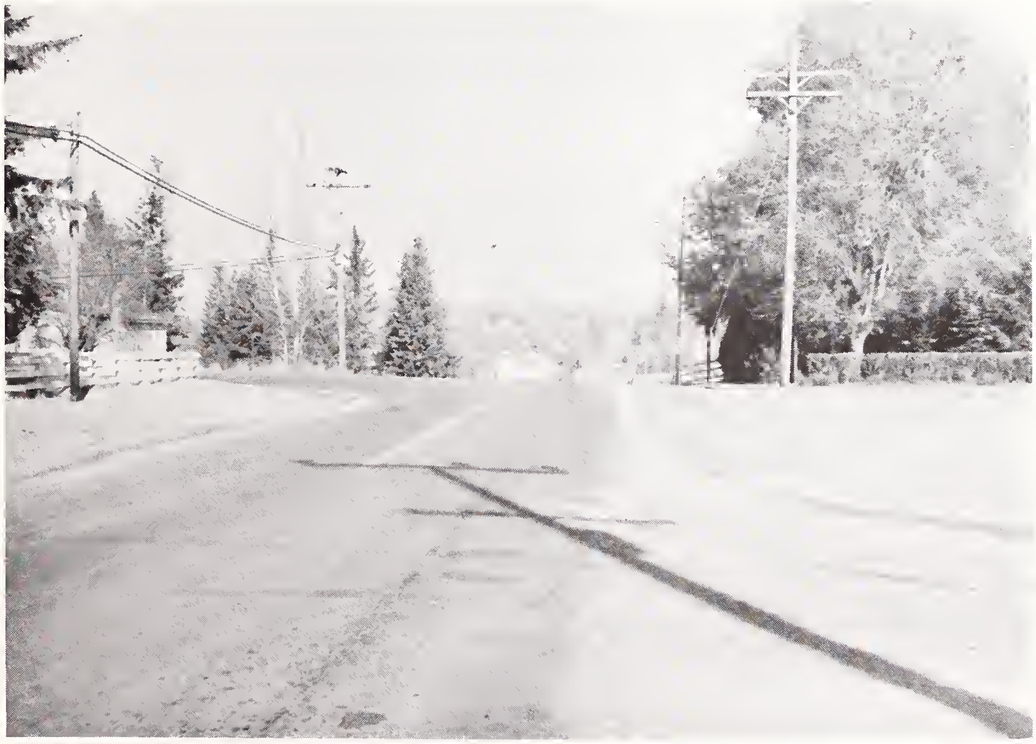
In addition, the redesigned intersection should be restriped with a conventional stripe pattern including a double solid centerline on Willow Glen and a stop bar and double solid centerline on Woodland.

Long-Term Improvement Cost Estimate

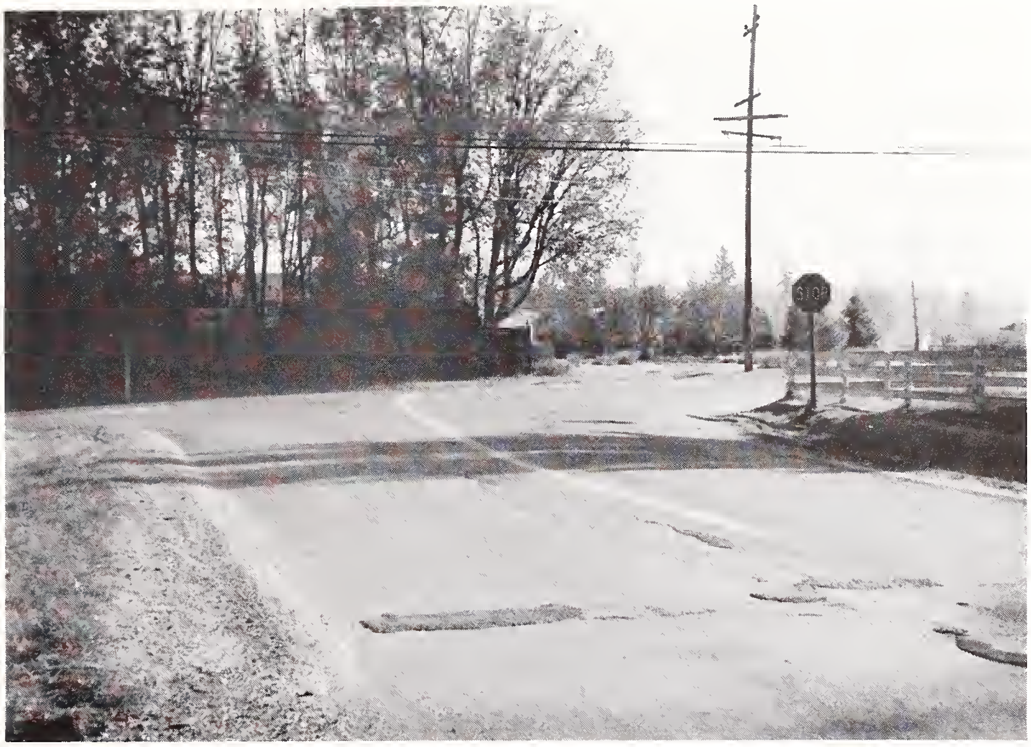
Quantity	Unit	Item Description	Unit Price	Total Price
800	cy	Excavation	$6/cy	$4,800.00
1400	sy	Asphalt Pavement (3" Full Depth)	$6/sy	$8,400.00
1000	lf	Paint - 4" Wide Solid Striping	$0.04/lf	40.00
TOTAL LONG-TERM IMPROVEMENT COST:				$13,240.00



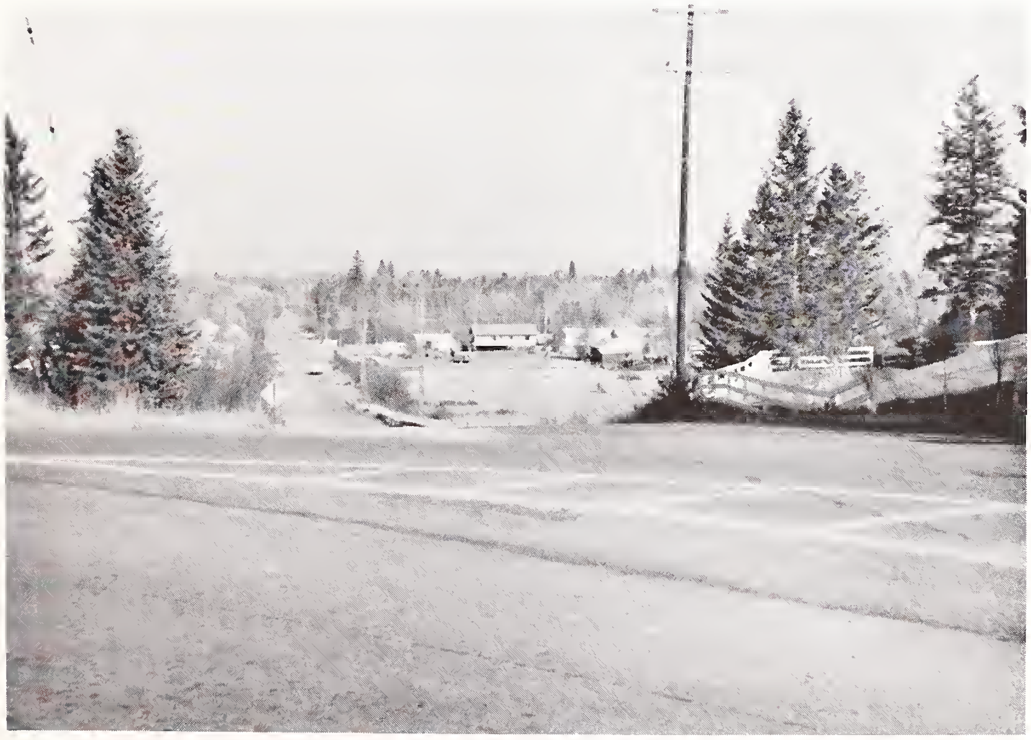
View of the Willow Glen and Woodland Avenue intersection from the north approach. Note the absence of object marker panels on the ends of the guardrails.



View of the intersection from the south approach on Willow Glen. Note that none of the north approach is visible from this point.



View of the intersection from the west approach on Woodland Drive. Note that, although the stop sign is apparent, the pavement striping does not convey a "stop" condition.



View of the intersection and the north approach. Note that the existing pavement markings are nonstandard and could be misleading.

ACCIDENT DATA

INTERSECTION OF WILLOW GLEN DRIVE (FAS 317) AND WOODLAND AVENUE (FAU 6726)

SITE NUMBER 6

ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
3	2	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
			2	1		3

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
				1	1	2	1		1		

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
		1					1	1				2										1	

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	*Dark*	*Dawn*	*Dusk*
4	2		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
5	1			

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
6			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Side-swipe*	*Non-Col*	*Head-on*	*Backing*
	2		1					2	1

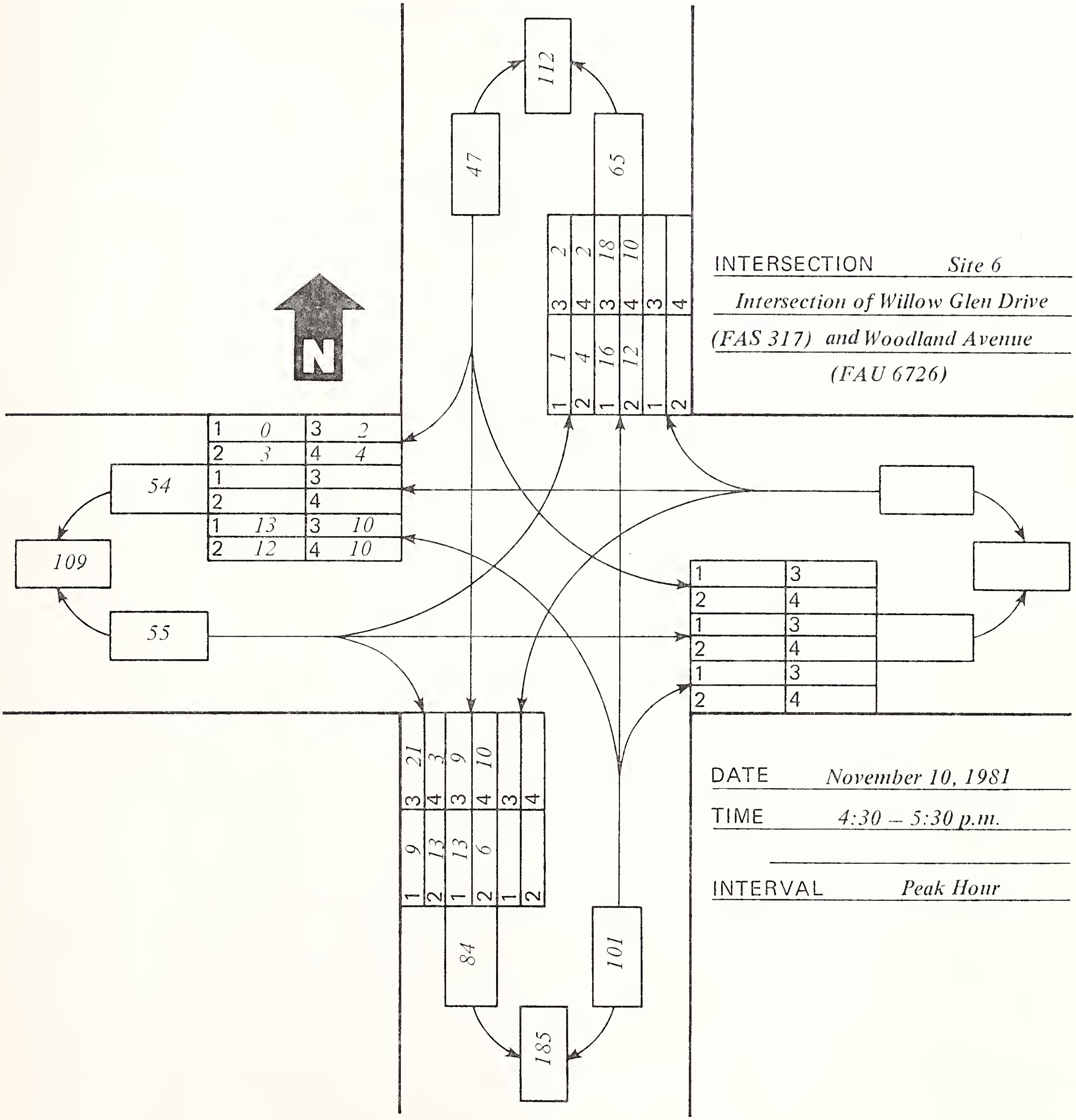
NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
	1					1	4	

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	2	1	1
Fatality	0	0	0
Property Dam. Only	1	1	0

TURNING MOVEMENTS



INTERSECTION *Site 6*

Intersection of Willow Glen Drive

(FAS 317) and Woodland Avenue

(FAU 6726)

DATE *November 10, 1981*

TIME *4:30 – 5:30 p.m.*

INTERVAL *Peak Hour*

DETERMINATION OF HAZARD INDEX

Site Number 6 Date November, 1981

Site Description Intersection of Willow Glen Drive (FAS 317) and Woodland Avenue (FAU 6726)

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	2.0 acc/yr	37	x 0.164 =	6.07
Accident Rate	2.9 acc/MVE	47	x 0.225 =	10.58
Accident Severity	7,500 dollars	55	x 0.191 =	10.51
Volume/Capacity Ratio	0.05	18	x 0.082 =	1.48
Sight Distance Ratio	0.49 (wt. avg.)	100	x 0.074 =	7.40
Driver Expectancy	5.2 (wt. avg.)	86	x 0.149 =	12.82
Information System Deficiencies	4.0 (wt. avg.)	67	x 0.115 =	7.71

Hazard Index: 56.57

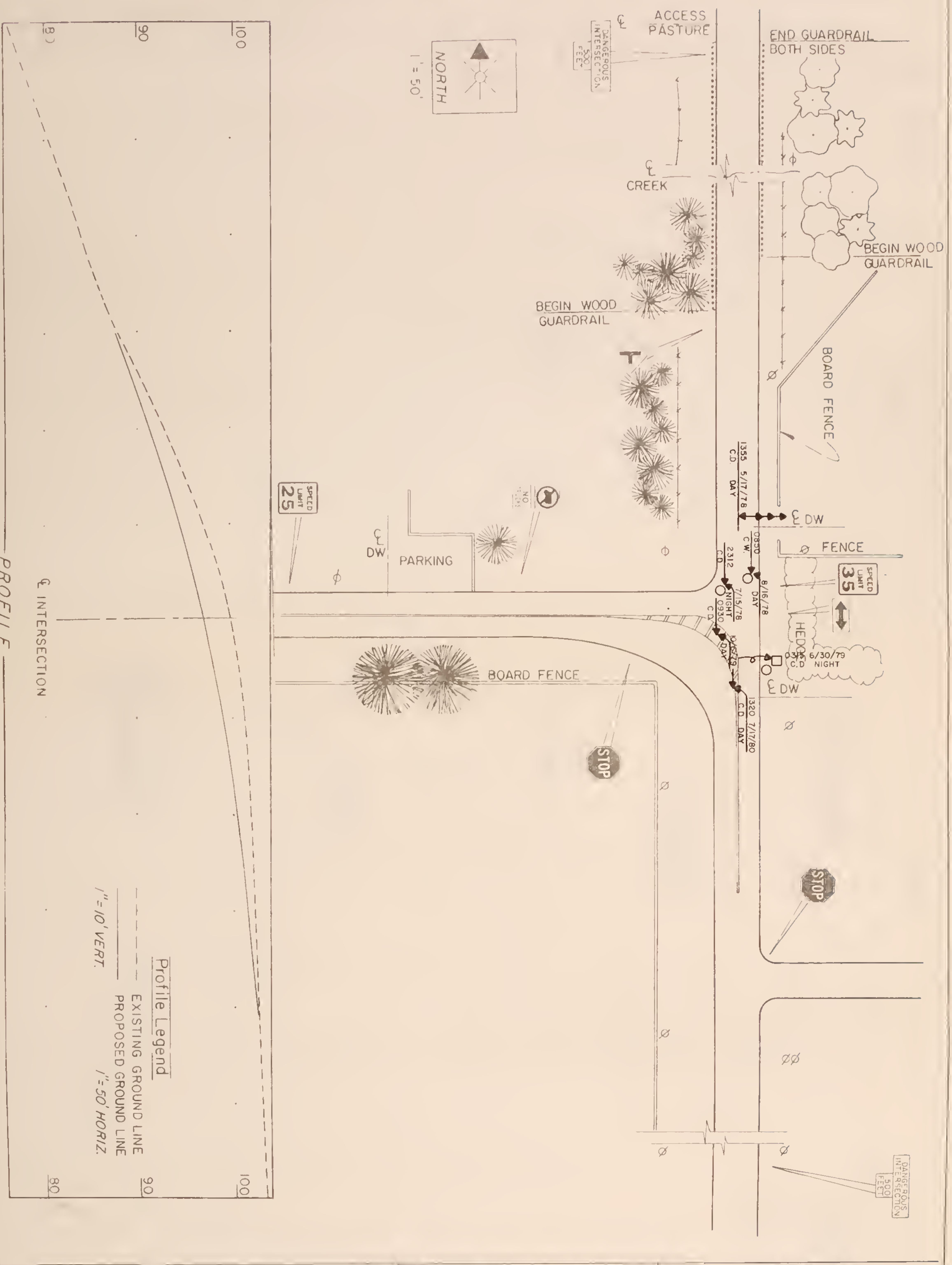
Cost of Recommended Improvements: $1,640.00

Cost Factor: 100

Priority Index = Hazard Index x .75 + Cost Factor x .25

56.57 x .75 + 100 x .25 = 67.43

EXISTING CONDITIONS & COLLISION DIAGRAM



SYMBOLS

VEHICLE PATH
PEDESTRIAN PATH
BACKING VEHICLE
PARKED VEHICLE
□ FIXED OBJECT
● FATAL ACCIDENT
○ INJURY ACCIDENT

COLLISION TYPES

REAR END
HEAD ON
SIDE SWIPE
OUT OF CONTROL
LEFT TURN
ANGLE

CONDITIONS

WEATHER:
F=Fog C=Clear R=Rain
S=Snow SL=Sleet

PAVEMENT: D=Dry W=Wet I=Icy

TIME 1400 7-05-75 DATE
WEATHER C.D. DAY LIGHT
PAVEMENT

FIGURE NO. 6A

Intersection of
Willow Glen Dr.
and Woodland
Avenue.

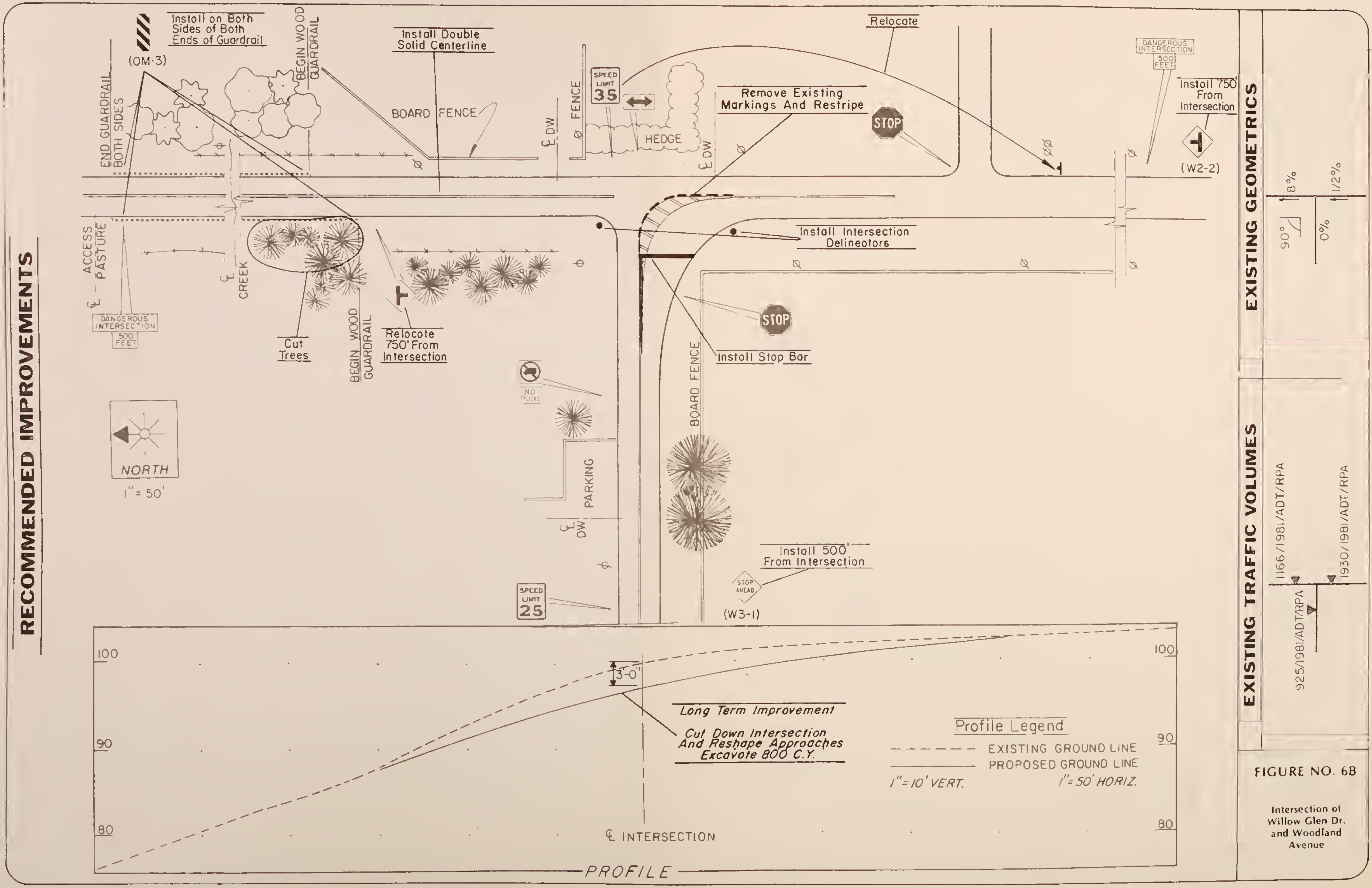


FIGURE NO. 6B

Intersection of Willow Glen Dr. and Woodland Avenue

SITE 7

SITE NUMBER 7

INTERSECTION OF CONRAD DRIVE (FAU 6715) AND WILLOW GLEN DRIVE (FAS 317)

A. Location:

Site 7 includes the "T" intersection of Willow Glen Drive and Conrad Drive. The site is located directly east of the Kalispell city limits, primarily in a moderately populated residential area.

B. Existing Conditions:

The asphalt pavement surface of Conrad Drive varies in width but is typically 24 feet wide in the area of the intersection, and the asphalt surface of Willow Glen Drive is 22 feet wide. The two roadways intersect at approximately 30 degrees, which results in a difficult turning maneuver and limits sight distance. Grades are generally quite flat, ranging from .25 to .50 percent through the section. There is no pavement striping through the site and the posted speed limit is 25 mph for Conrad Drive at the intersection and 35 mph for Willow Glen Drive. The east and west approaches to the intersection are reverse curves bordered by large trees and shrubs which tend to limit sight distance through the curves. A "Reverse Curve" warning sign is placed well in advance of the intersection at the beginning of a series of curves. A stop sign is located on the south approach (Willow Glen Drive) approximately 60 feet from the intersection. Field observations indicate that most drivers stop closer to the intersection. Existing conditions at this site are depicted in the site sketch (Figure 7A) and in photographs of the site (Plate 7).

ADT for the site was determined from an analysis of 24-hour machine traffic counts conducted by the Montana Department of Highways and peak hour turning movements conducted by Robert Peccia and Associates. Traffic was determined to be 1,660 vehicles per day on the south approach, 1,860 vehicles per day on the west approach, and 1,900 vehicles per day on the east approach. Conrad and Willow Glen Drive appear to be most frequently used by the local residents.

C. Accident History:

Only one accident was reported at this intersection during the study period. It involved an eastbound vehicle on Conrad Drive that crossed the centerline and struck a vehicle parked on the shoulder of the road adjacent to the intersection. The accident rate at this location is 0.4 accidents per million vehicles entering.

D. Recommendations:

The geometrics of this intersection constitute a problem that cannot be addressed by a short-term improvement, although several short-term im-

provements can correct some deficiencies in sight distance and delineation of the intersection.

The following short-term improvements are recommended:

1. Remove all the visual obstructions (trees and shrubs) within right-of-way limits on the south side of the east approach for a distance of 300 feet from the intersection.
2. Install a double solid centerline and shoulder stripes 500 feet from the south and west approaches. The east approach should be striped up to the Stillwater Bridge. A stop bar should be painted adjacent to the stop sign on the south approach.
3. Install a double arrow warning sign (W1-7) across from the south approach visible from no less than 500 feet back on Willow Glen Drive.
4. Install a curve warning sign (W1-2) for the westbound traffic 250 feet from the curve on the west approach of Conrad Road.
5. All brush that limits sight distance should be cleared from the inside of the curve on the west approach to the intersection.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
12,000	lf	Paint Striping 4" Solid	$0.04/lf	480.00
1	ea	Install Double Arrow Warning Sign (W1-7), 48" x 24"	$163/ea	163.00
1	ea	Install Curve Warning Sign (W1-2)	$130/ea	130.00
¼	ac	Clearing and Grubbing	$2,000/ac	1,000.00
TOTAL COST:				$1,273.00

BENEFIT/COST RATIO: 0.17

Long-Term Improvement:

This intersection should be realigned as close as possible to a standard 90-degree configuration to provide for the heavy west-to-south movement of traffic. This would entail purchasing approximately one-quarter acre of private land on the southeast corner.

Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
700	cy	Excavation	$6/cy	$4,200.00
1600	sy	Asphalt Pavement, 3" Full Depth	$6/sy	9,600.00
500	lf	Remove and Replace Wood Fence	$2/lf	1,000.00
5	ea	Relocate Signs - Single Pole	$60/ea	300.00

TOTAL LONG-TERM IMPROVEMENT COST: * $23,700.00

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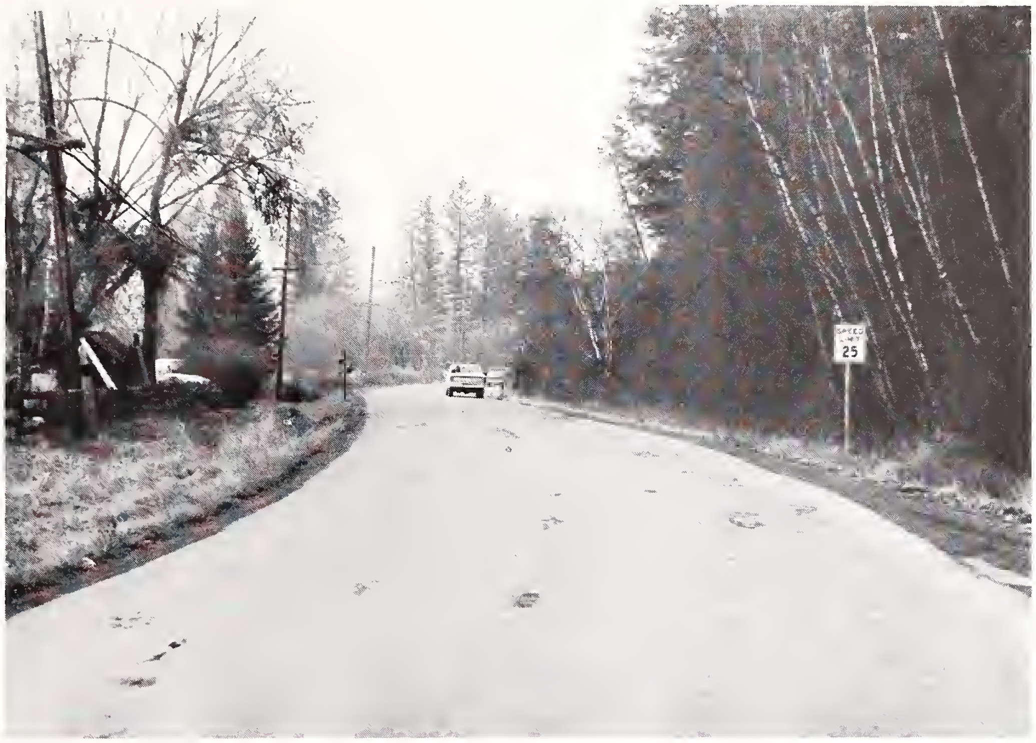
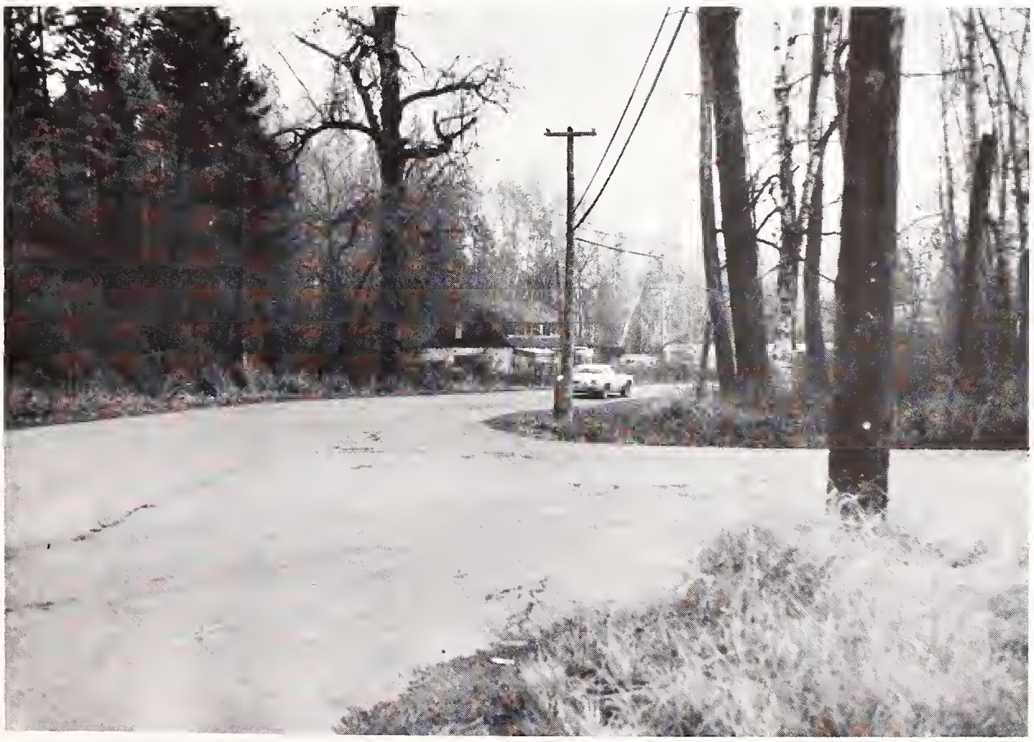
* No cost is included for the acquisition of approximately ¼ acre of right-of-way.



West approach on Conrad Drive as viewed from the intersection. Note the trees and shrubs on the right side blocking sight distance around bend.



View of the intersection and the east approach. Note the trees and shrubs on the right obstructing sight distance.

ACCIDENT DATA

INTERSECTION OF CONRAD DRIVE (FAU 6715) AND WILLOW GLEN DRIVE (FAS 317)

SITE NUMBER 7

ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
1	0	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
			1			

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
											1

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
																					1		

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Daylight	Dark	Dawn	Dusk
	1		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
1				

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
1			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
						1			

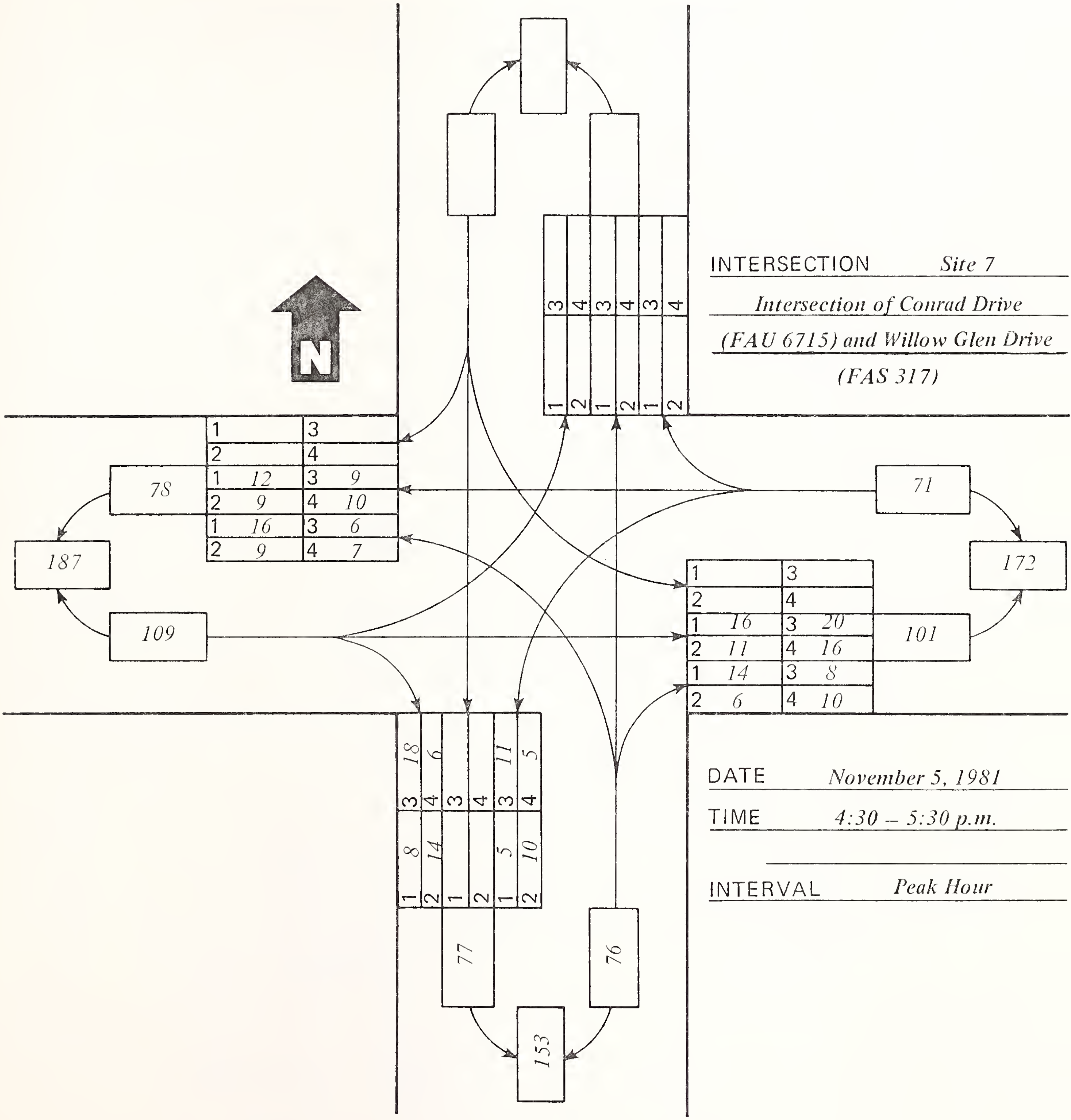
NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
								1

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	0	0	0
Fatality	0	0	0
Property Dam. Only	1	0	0

TURNING MOVEMENTS



INTERSECTION *Site 7*

Intersection of Conrad Drive

(FAU 6715) and Willow Glen Drive

(FAS 317)

DATE *November 5, 1981*

TIME *4:30 – 5:30 p.m.*

INTERVAL *Peak Hour*

DETERMINATION OF HAZARD INDEX

Site Number 7 Date November, 1981

Site Description Intersection of Conrad Drive (FAU 6715) and Willow Glen Drive (FAS 317)

Indicator	Data Value	Indicator Value	Weight		Partial H.I.'s
Number of Accidents	0.3 acc/yr	13	x 0.164	=	2.13
Accident Rate	0.4 acc/MVE	7	x 0.225	=	1.58
Accident Severity	7,000 dollars	54	x 0.191	=	10.31
Volume/Capacity Ratio	0.08	24	x 0.082	=	1.97
Sight Distance Ratio	0.97 (wt. avg.)	32	x 0.074	=	2.37
Driver Expectancy	2.7 (wt. avg.)	44	x 0.149	=	6.56
Information System Deficiencies	5.0 (wt. avg.)	83	x 0.115	=	9.55

Hazard Index: 34.47

Cost of Recommended Improvements: $1,273.00

Cost Factor: 100

Priority Index = Hazard Index x .75 + Cost Factor x .25

34.47 x .75 + 100 x .25 = 50.85

EXISTING CONDITIONS & COLLISION DIAGRAM

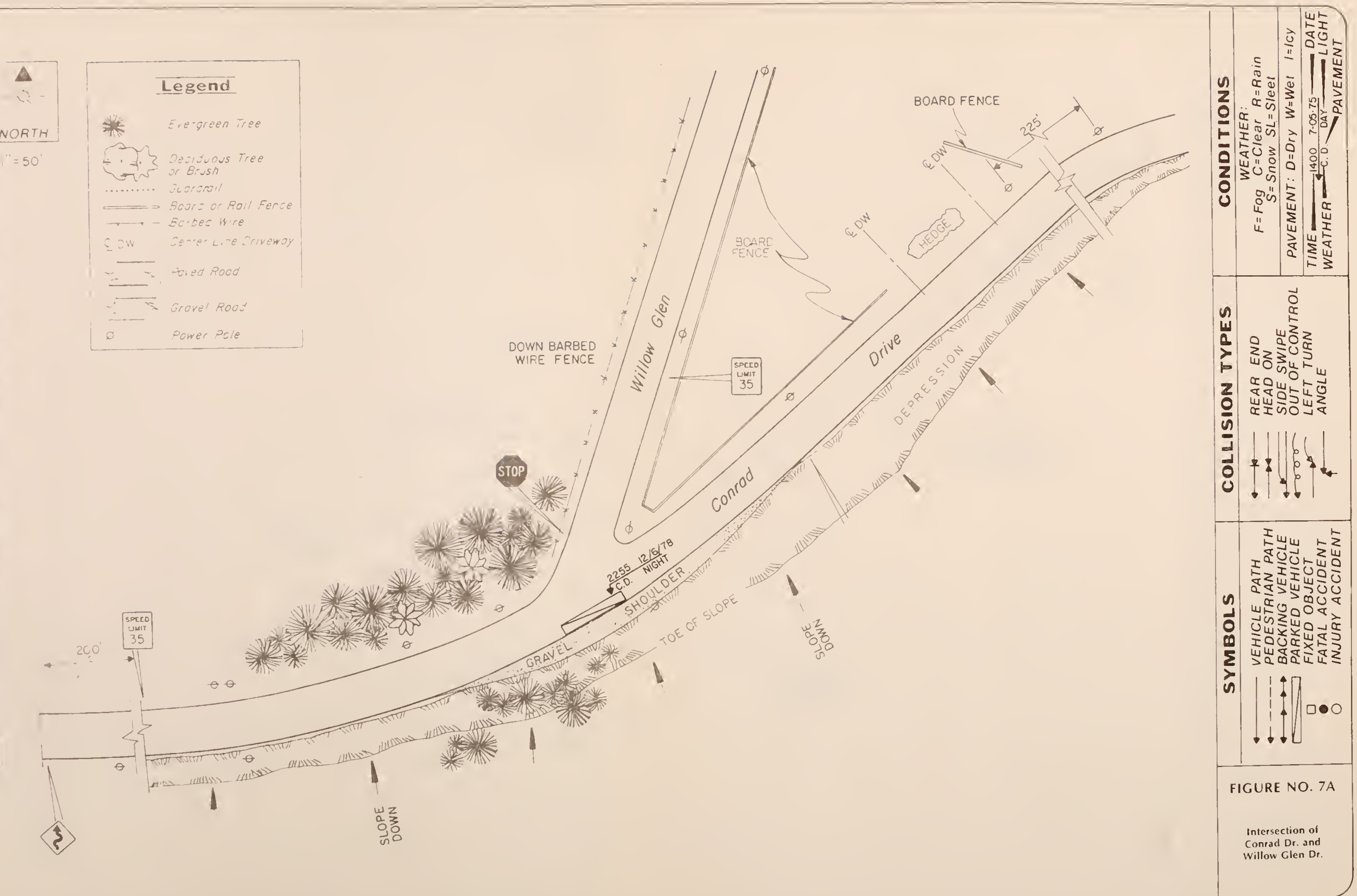
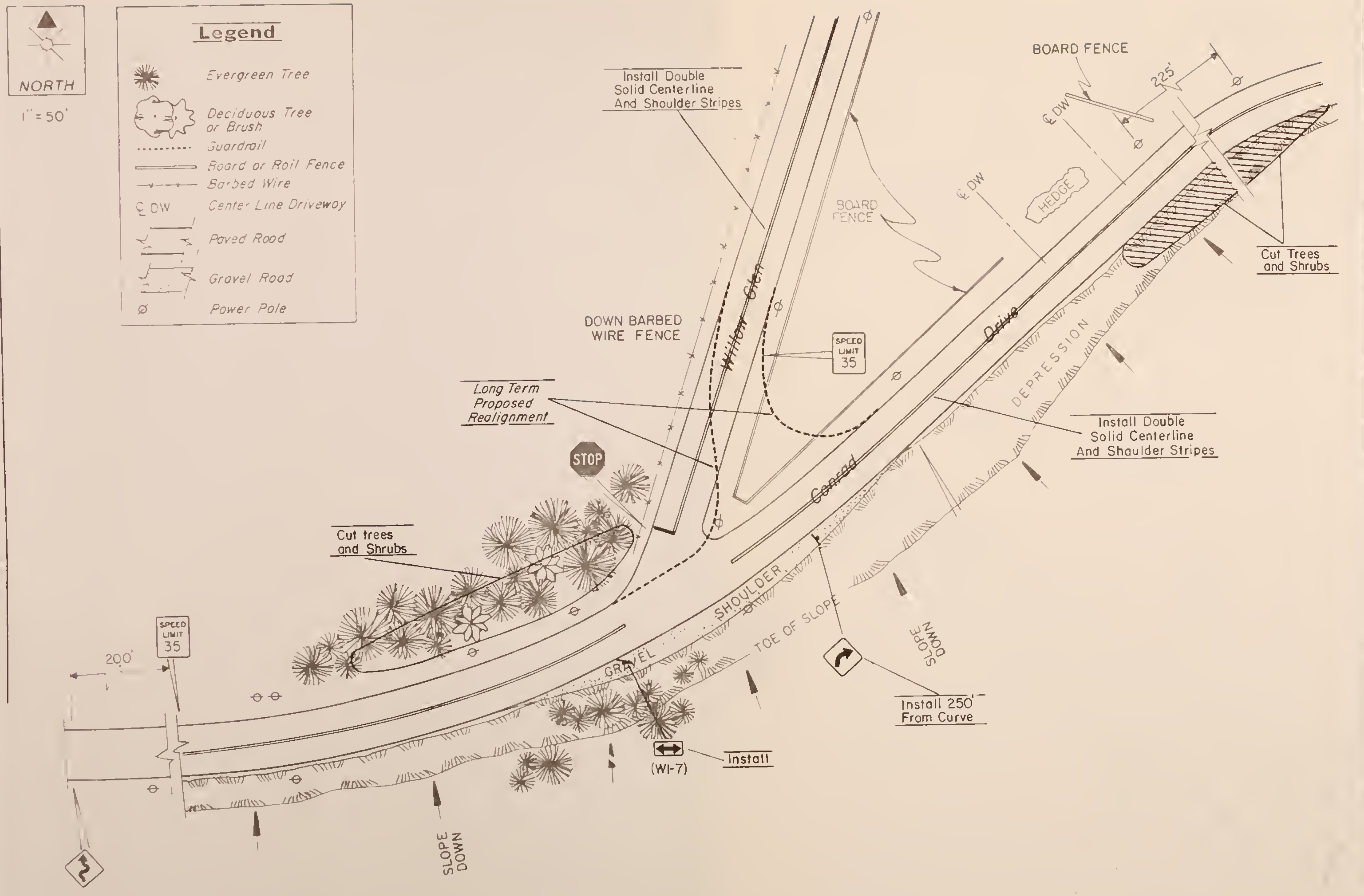


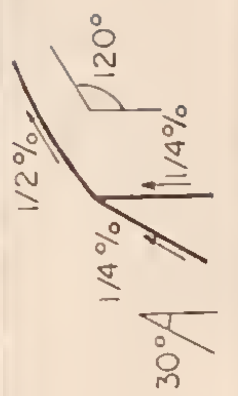
FIGURE NO. 7A

Intersection of
Conrad Dr. and
Willow Glen Dr.

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

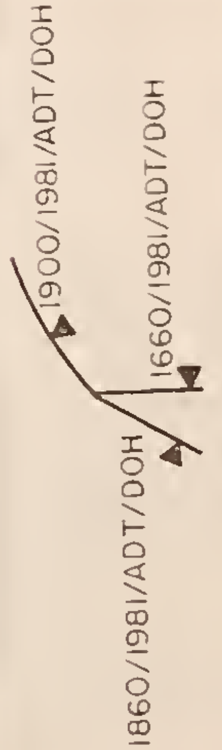


FIGURE NO. 7B

Intersection of Conrad Dr. and Willow Glen Dr.

S
I
T
E
8

SITE NUMBER 8

INTERSECTION OF CONRAD DRIVE (FAU 6715) AND ANDERSON LANE

A. Location:

Site 8 includes the intersection of Conrad Drive with Anderson Lane near the Stillwater River east of the Kalispell city limits. The site is located in a moderately developed rural residential area.

B. Existing Conditions:

Anderson Lane intersects Conrad Drive in the middle of a 125-degree bend in the road. Conrad Drive, which has been newly resurfaced, has an asphalt pavement width of 24 feet through the roadway section examined. Anderson Lane is primarily a 22-foot-wide gravel-surfaced roadway; however, approximately 100 feet of roadway have been surfaced at the intersection. Grades are uniform and flat on the north and south approaches, but the grade on the west approach falls at .5 percent into the corner. Field observations indicate that eastbound vehicles on Conrad Drive tend to be thrust outward slightly in the curve, but westbound vehicles experience few problems.

There are no pavement markings through the site, probably because of the recent surfacing. Curve warning signs with 20 mph advisory speeds are posted on Conrad Drive approximately 300 feet in advance of the intersection. A directional arrow warning sign mounted on a cottonwood tree and a series of flexible delineators are located on the east side of the intersection. Although the existing reflectors delineate the east side of the intersection, they do not effectively guide the motorist through the intersection. Obstructions are generally located greater than six feet from the edge of the roadway, except on the inside of the corner. Existing conditions are depicted in the accompanying sketches and photographs.

Based upon 24-hour traffic counts conducted by the Montana Department of Highways, the 1981 ADT for Conrad Drive was determined to be 1,900 vehicles per day. Traffic on Anderson Lane is estimated to be 75 vehicles per day.

C. Accident History:

Five nighttime and two daytime accidents were reported at this location during the three-year study period. In all cases the weather was clear, and in five accidents the pavement was dry. With the exception of one head-on collision, all of the other accidents were single-vehicle type, in which the motorist lost control and the vehicle left the road in the 90-degree bend on Conrad Drive at Anderson Lane. Five of the accidents involved injuries, mainly due to the vehicles striking fixed objects after leaving the road.

This intersection has an accident rate of 3.5 accidents per million vehicles entering.

D. Recommendations: (See Figure 8B)

This intersection is located at the end of two long tangent approaches on Conrad Drive. The accident records indicate that motorists are having trouble distinguishing the exact location and configuration of this intersection. The presence of the cottonwood trees on the outside of the curve tends to compound the severity of the accidents.

The following improvements are recommended:

1. Install a double solid centerline and shoulder stripes beginning 500 feet north of the intersection and continuing west on Conrad Drive over the Stillwater Bridge. This striping program should be done in conjunction with a similar program recommended for Site 7, "Willow Glen and Conrad Drive".
2. Although reflectors exist at this intersection, it is recommended that a complete reflectorized road delineation system be installed. Reflectorized delineators should be installed on the Conrad Drive approaches beginning at the bridge on the west approach, through the intersection, and continuing for 500 feet on the north approach as shown on Figure 8B. The delineator should be placed in such a pattern as to lead the motorist through this intersection.
3. Relocate the curve warning sign (W1-1) on the north approach 750 feet from the intersection. The curve sign should be relocated to 500 feet from the intersection. A vehicle equipped with a ball bank indicator was used to evaluate the safe speed for traveling through this curve. The existing 20 mph speed plates (W13-1) are appropriate and should be retained. It should be noted that the existing superelevation in this curve is somewhat irregular. When the existing pavement has deteriorated and requires resurfacing, the curve should be reconstructed with a uniform superelevation based on an engineering design.
4. Relocate the directional arrow (W1-6) on the east side of the intersection so that it can be clearly seen for at least 500 feet away on the north approach. For the west approach traffic, three chevron alignment signs (W1-8) should be installed 20 feet apart on the east side of the intersection and two on the west approach so they can be clearly seen for at least 500 feet back on the west approach. The 18" x 24" sign should be used.
5. Relocate two power poles that are presently situated immediately adjacent to the intersection, one on the inside of the curve and one across the intersection from it. They should be placed as far from the edge of road as right-of-way permits. If at all possible, the power lines should be rerouted around this corner and the two power poles at this intersection should be removed..
6. Paint a stop bar on the Anderson Lane approach.
7. Install a 400-watt high-pressure sodium vapor luminaire on the inside of the curve. A mounting height of 45 feet is recommended.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
4500	lf	Paint Striping 4" Wide Solid	$0.04/lf	180.00
19	ea	Install Reflectorized Delineator 4" x 4", Design "C"	$18/ea	342.00
2	ea	Relocate Curve Warning Sign (W1-1)	$60/ea	120.00
2	ea	Install 15 mph Advisory Speed Plate (W13-1)	$50/ea	100.00
1	ea	Install Directional Arrow (W1-6), 48" x 24"	$163/ea	163.00
5	ea	Install Chevron Alignment Sign (W1-8) 18" x 24"	$105/ea	525.00
1	ea	Install Painted Stop Bar	$20/ea	20.00
1	ea	Install 400-watt High-Pressure Sodium Vapor Luminaire	$1,800/ea	1,800.00
TOTAL COST:				$3,250.00

BENEFIT/COST RATIO: 11.07

Long-Term Improvement

Many of the cottonwood trees on the east side of the intersection are on private property. These trees should be cut down and removed to create a 50-foot-wide space free from fixed objects.

Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
20	ea	Remove Trees 2' Dia.	$200/ea	$4,000.00
TOTAL LONG-TERM IMPROVEMENT COST:				* $4,000.00

* Estimate does not include right-of-way or easement costs

View of the intersection from the west approach on Conrad Drive.

View from Anderson Lane of the intersection and the north approach. Note the cottonwood trees on right.

ACCIDENT DATA

INTERSECTION OF CONRAD DRIVE (FAU 6715) AND ANDERSON LANE

SITE NUMBER 8 *ACCIDENT PERIOD* 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
1	4	2

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
2	2	1		2		

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
1		1					2	1	1	1	

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
1	3											1			1								1

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Daylight	*Dark*	*Dawn*	*Dusk*
2	5		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
5			2	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
7			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Sideswipe*	*Non-Col*	*Head-on*	*Backing*
			6					1	

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
	1	1	1	2				2

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	1	3	1
Fatality	0	0	0
Property Dam. Only	0	1	1

Robert Peccia & Associates

DETERMINATION OF HAZARD INDEX

Site Number 8 Date November, 1981

Site Description Intersection of Conrad Drive (FAU 6715) and Anderson Lane

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	2.3 acc/yr	40	x 0.164 =	6.56
Accident Rate	3.5 acc/MVE	53	x 0.225 =	11.93
Accident Severity	12,600 dollars	69	x 0.191 =	13.18
Volume/Capacity Ratio	0.04	13	x 0.082 =	1.07
Sight Distance Ratio	3.5 (wt. avg.)	0	x 0.074 =	0
Driver Expectancy	1.8 (wt. avg.)	30	x 0.149 =	4.47
Information System Deficiencies	1.8 (wt. avg.)	30	x 0.115 =	3.45

Hazard Index: 40.66

Cost of Recommended Improvements: $3,250.00

Cost Factor: 100

Priority Index = Hazard Index x .75 + Cost Factor x .25

40.66 x .75 + 100 x .25 = $55.50

EXISTING CONDITIONS & COLLISION DIAGRAM

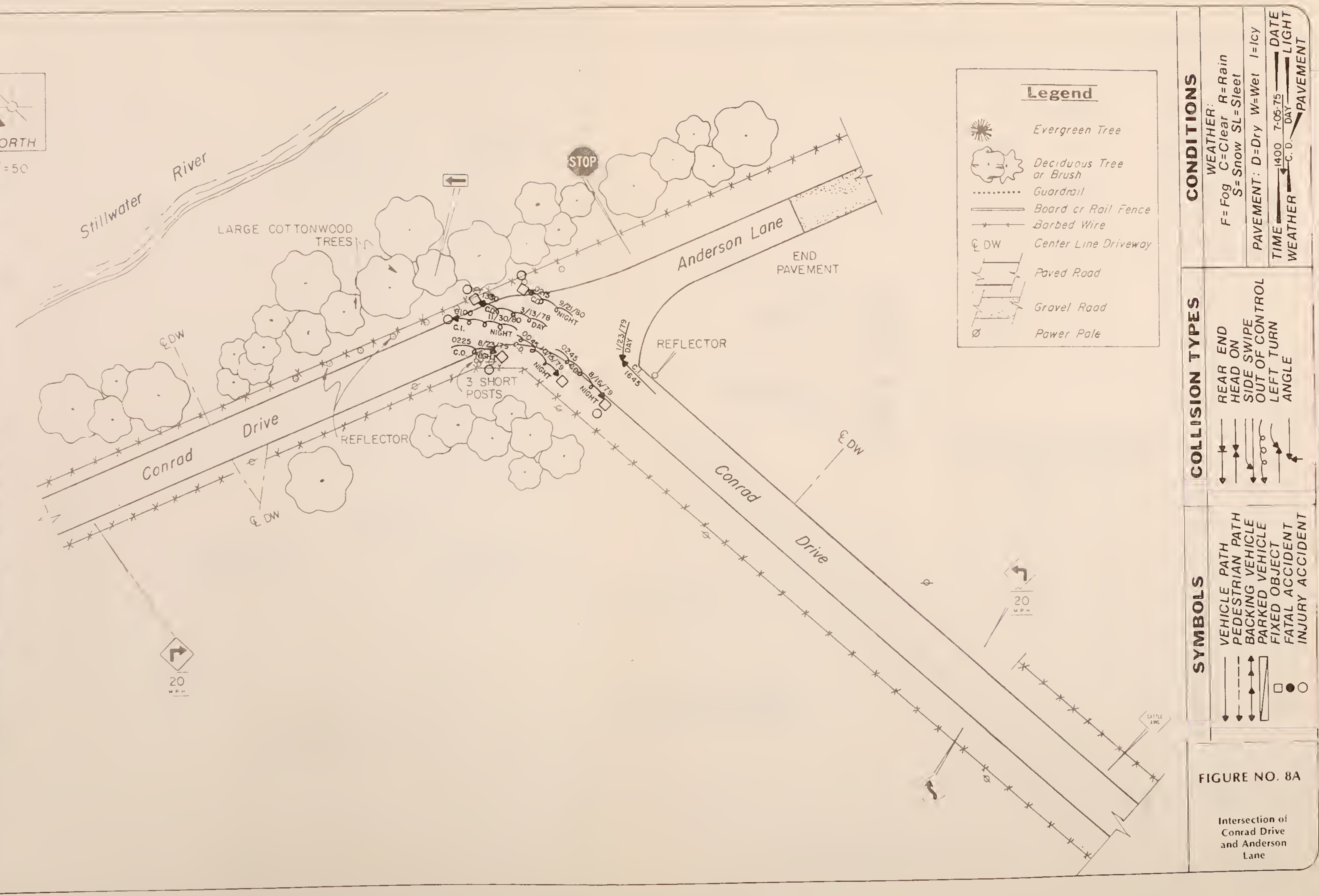


FIGURE NO. 8A

Intersection of Conrad Drive and Anderson Lane

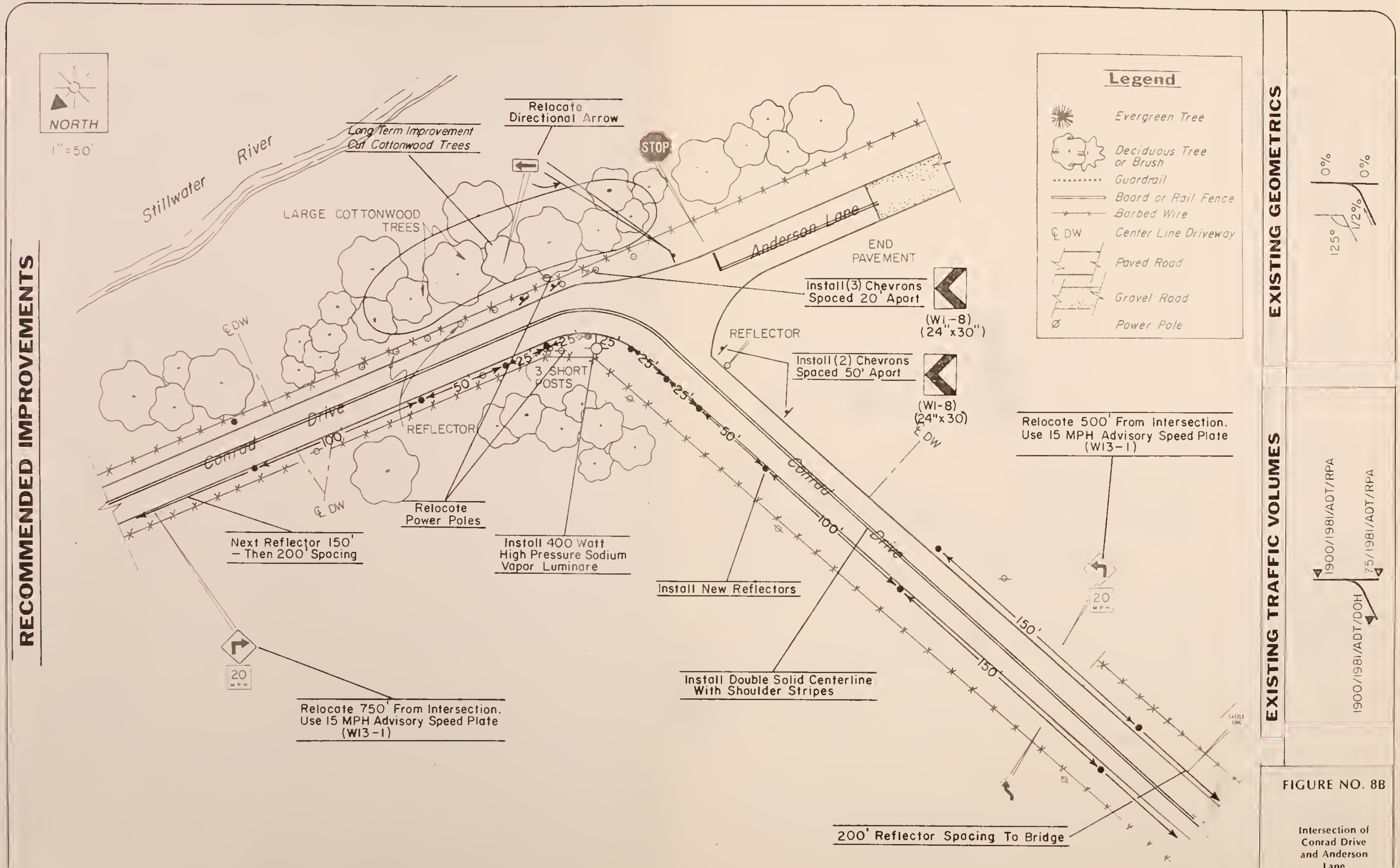


FIGURE NO. 8B

Intersection of
Conrad Drive
and Anderson
Lane

SITE 9

SITE NUMBER 9

SOUTH WHITEFISH STAGE ROAD (FAU 6728)

A. Location:

Site 9 includes a broad curve which begins approximately 300 feet north of the Stillwater River Bridge on the Whitefish Stage Road just north of the city limits of Kalispell. The road provides a north-south link between rural residential areas in the north Flathead valley and the city of Kalispell. The road also serves an industrial area located south of the site.

B. Existing Conditions:

The asphalt paved roadway of Site 9 has a general width of 22 feet. The roadway is marked with a double solid centerline and shoulder stripes delineating ten-foot driving lanes and one-foot shoulders. Grades are consistent at .75 percent through the site and slope toward the south. The road alignment changes 130 degrees through the curve at this site. The posted speed limit for this portion of Whitefish Stage Road is 25 mph.

Curve warning signs are located on the north and south approaches to the site, as shown in Figure 9A. In addition, two sections of non-reflectorized guard rail have been installed on the outer edge of the curve. Sight distance is limited by a five-foot-high hedge and residential development on the inside portion of the curve. Several power poles are also located close to the edge of the roadway on the inside of the curve. In addition, several driveways are hidden from view. Photographs contained in Plates 9A and 9B depict several hazardous conditions that presently exist at the site.

Based upon Montana Department of Highways traffic counts for this section of the Whitefish Stage Road, it was determined that the 1981 ADT is 2,640 vehicles per day.

C. Accident History:

Seventeen accidents were reported during the three-year period for this section of road. In 15 cases the weather was clear and in ten cases the pavement was dry. Considering the predominantly clear and dry conditions, 14 of the accidents occurred because the motorist failed to negotiate the bend, lost control and left the road. Nine accidents occurred in the dark, and ten of the accidents involved injuries, mainly due to the vehicles leaving the road and striking fixed objects. This section of the South Whitefish Stage Road has an accident rate of 5.9 accidents per million vehicles entering.

D. Recommendations:

The major problems of road alignment and sight distance limitations cannot be addressed as short-term improvements. However, several improve-

ments to the road delineation and signing would aid the motorist in negotiating this section of road.

These recommended short-term improvements are as follows:

1. The existing curve warning signs (W1-2) should be removed.
2. Curve warning signs (W1-1) with 25 mph advisory speed plates (W13-1) should be installed. A setback distance of 750 feet is recommended for the north approach. For the south approach, an oversized (36"x36") curve warning sign should be located 250 feet from the curve. By using a vehicle equipped with a ball bank indicator, the appropriate safe speed for this curve was determined to be 25 mph.
3. Fully reflectorize both sides of the road starting at the north end of the bridge and extending 500 feet north of the existing guard rail as shown on Figure 9B.
4. Remove the directional arrow (W1-6) on the west side of the curve.
5. Relocate the power pole on the east side of curve to a location with the maximum offset from the edge of the road.
6. Continue the existing roadway striping in this section.
7. Install a 400-watt high-pressure sodium vapor luminaire in the curve. A mounting height of 45 feet is recommended.
8. Install chevron signs on the west side of the curve as shown on Figure 9B. Use the 24" x 30" sign.
9. Install wraparound end sections to the existing guard rail sections.
10. Relocate the existing speed limit sign to a location south of the bridge.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
2	ea	Install Curve Warning Sign (W1-1)	$60/ea	$ 120.00
2	ea	Install 25 mph Advisory Speed Plate (W13-1)	$50/ea	100.00
14	ea	Install Reflectorized Delineator, 4" x 4", Design "F"	$15.50/ea	217.00
11	ea	Install Reflectorized Delineator, 4" x 4", Design "C"	$18/ea	198.00
10	ea	Install Chevron Sign (W1-8) (24" x 30")	$105/ea	1,050.00
1	ea	Remove Directional Arrow Sign	$35/ea	35.00

Improvement Cost Estimate
(cont.)

Quantity	Unit	Item Description	Unit Price	Total Price
4	ea	Install Wraparound End Sections to Existing Guard Rail	$100/ea	400.00
1	ea	Relocate Speed Limit Sign	$60/ea	60.00
1	ea	400-watt Sodium Vapor Luminaire	$1,800/ea	1,800.00
TOTAL COST:				$3,980.00

BENEFIT/COST RATIO: 14.87

Long-Term Improvements:

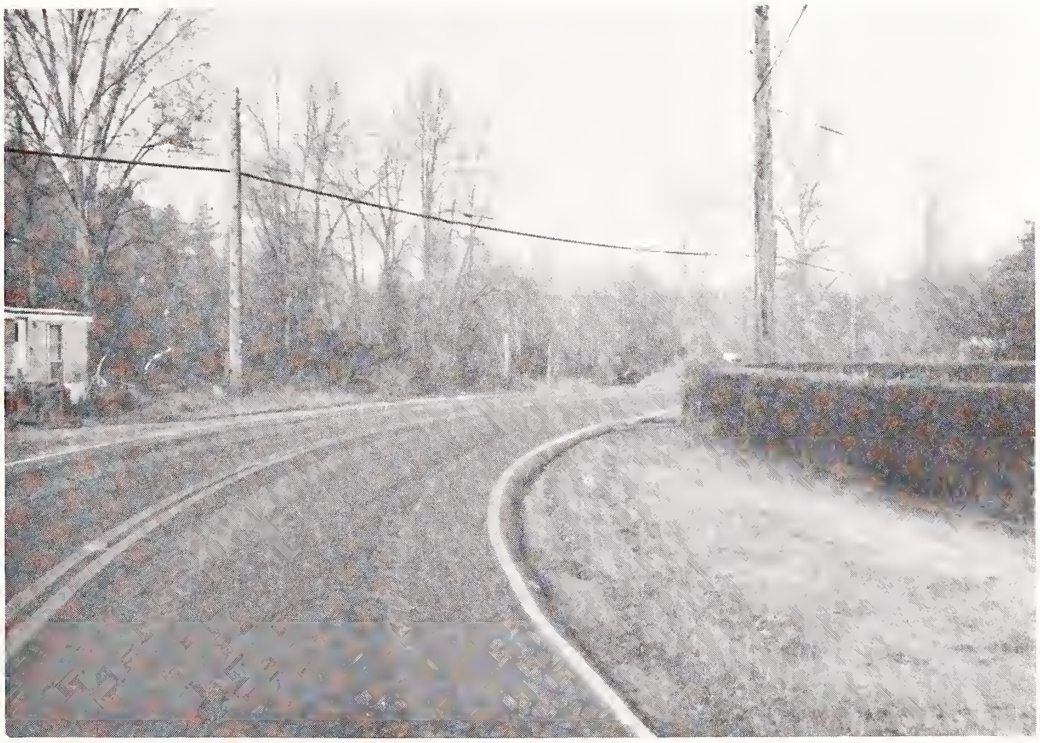
The optimum solution is the realignment of this section of road. In the interim, the removal of the hedge and spruce trees on the east side of the road, which are located on private property, should be actively pursued. If right-of-way acquisition is possible, shifting the centerline of the road 20 feet to the east would allow for the flattening of the horizontal curve and provide the necessary sight distance. Approximately 6,000 square feet of right-of-way is required.

Long-Term Improvement Cost Estimate

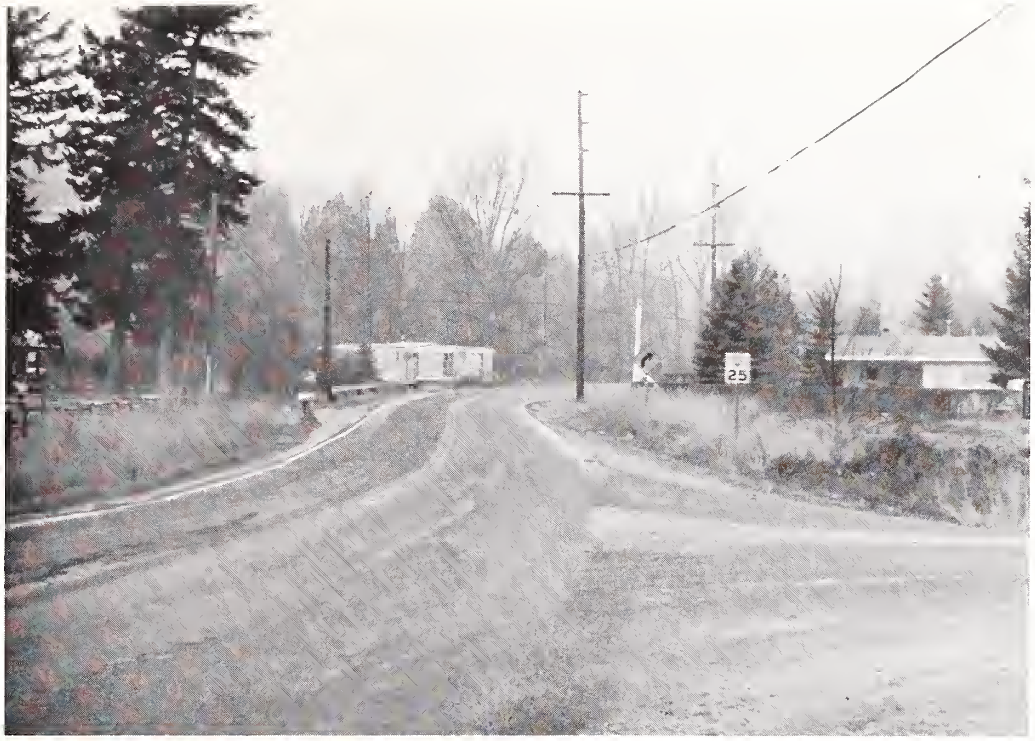
Quantity	Unit	Item Description	Unit Price	Total Price
1600	sy	Remove and Reconstruct 24' Wide Asphalt Roadway 5" Full Depth	$12/sy	$19,200.00
1	ea	Relocate Signs and Restripe	Lump Sum	800.00
TOTAL LONG-TERM IMPROVEMENT COSTS:				* $20,000.00

* Estimate does not include right-of-way acquisition costs.

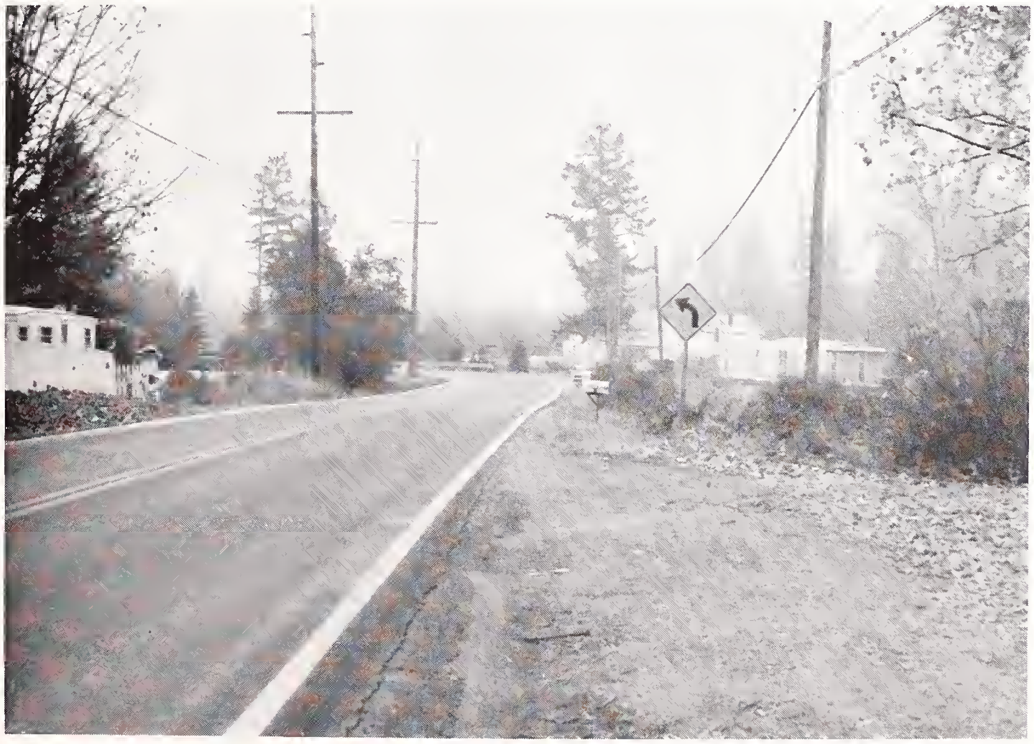
View of the curve on the South Whitefish Stage Road from the north.



Limited view of the same curve from the south approach. Note the hedge, which effectively reduces the sight distance to less than 200 feet.



View of the south approach to the curve. Note River Drive entering from the right.



View of the north approach to the curve. Note proximity of curve warning sign to the curve.

ACCIDENT DATA

SOUTH WHITEFISH STAGE ROAD (FAU 6728)

SITE NUMBER 9 *ACCIDENT PERIOD* 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
3	5	8

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
1	3	2	1	3	4	2

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
2			1		2	2			4	2	3

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
1	2			1	1		1				2	1		1	1		1		1				3

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	*Dark*	*Dawn*	*Dusk*
6	9		1

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
10	2		4	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
15	1		

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Side-swipe*	*Non-Col*	*Head-on*	*Backing*
1		1	11				3		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
2	3	3	4					4

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	2	3	5
Fatality	0	0	0
Property Dam. Only	1	2	3

Robert Peccia & Associates

DETERMINATION OF HAZARD INDEX

Site Number 9 Date November, 1981

Site Description South Whitefish Stage Road (FAU 6728)

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	5.3 acc/yr	60	x 0.164 =	9.84
Accident Rate	5.9 acc/MVE	75	x 0.225 =	16.88
Accident Severity	12,131 dollars	68	x 0.191 =	12.99
Volume/Capacity Ratio	0.56	100	x 0.082 =	8.20
Sight Distance Ratio	0.42 (wt. avg.)	100	x 0.074 =	7.40
Driver Expectancy	2.5 (wt. avg.)	42	x 0.149 =	6.26
Information System Deficiencies	1.5 (wt. avg.)	25	x 0.115 =	2.88

Hazard Index: 64.45

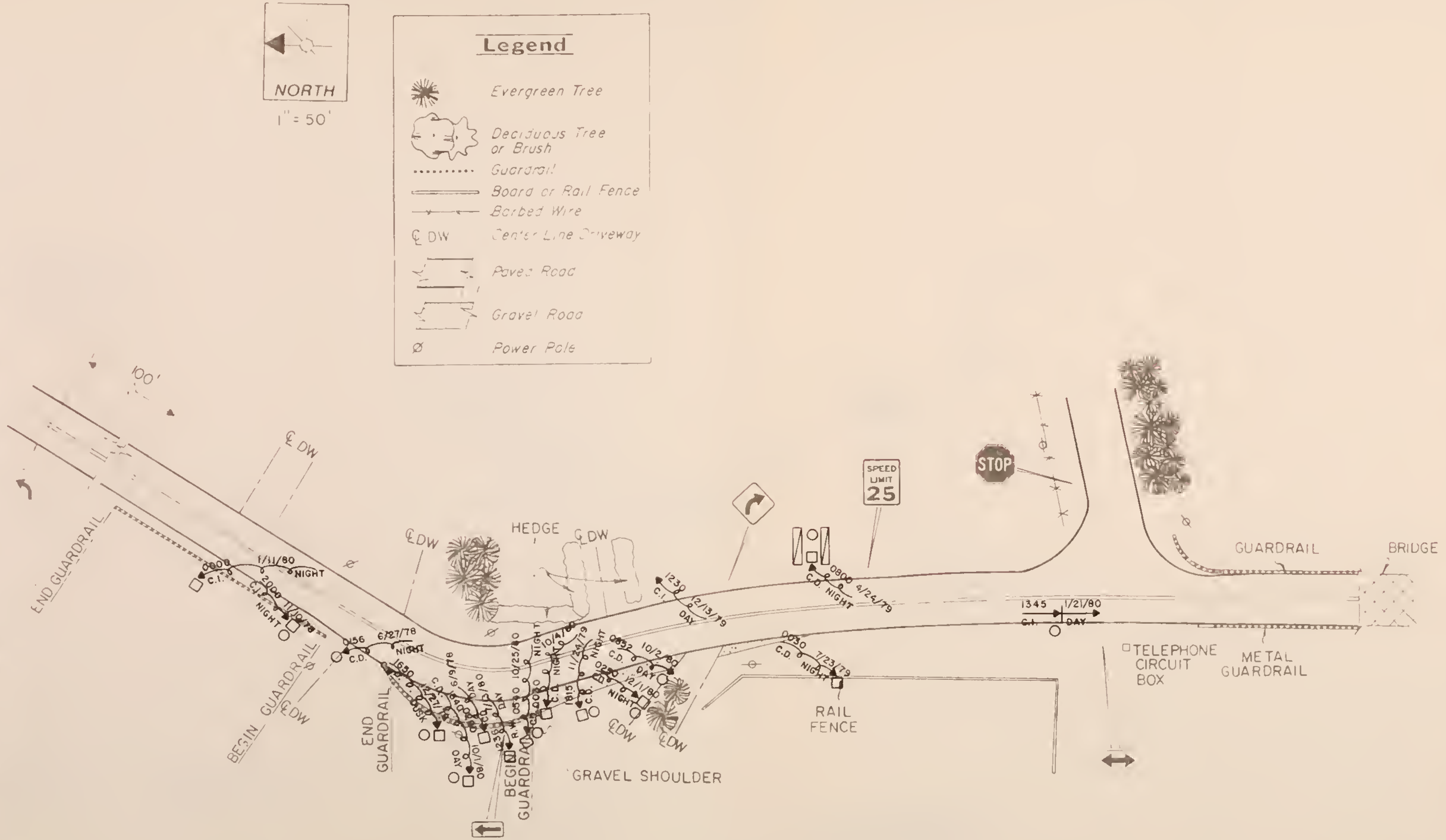
Cost of Recommended Improvements: $3,980.00

Cost Factor: 100

Priority Index = Hazard Index x .75 + Cost Factor x .25

64.45 x .75 + 100 x .25 = 73.34

EXISTING CONDITIONS & COLLISION DIAGRAM



CONDITIONS

WEATHER:
F=Fog C=Clear R=Rain
S=Snow SL=Sleet

PAVEMENT: D=Dry W=Wet I=Icy

TIME 1400 DATE 7-05-75
LIGHT DAY
WEATHER C
PAVEMENT D

COLLISION TYPES

- REAR END
- HEAD ON
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- ANGLE

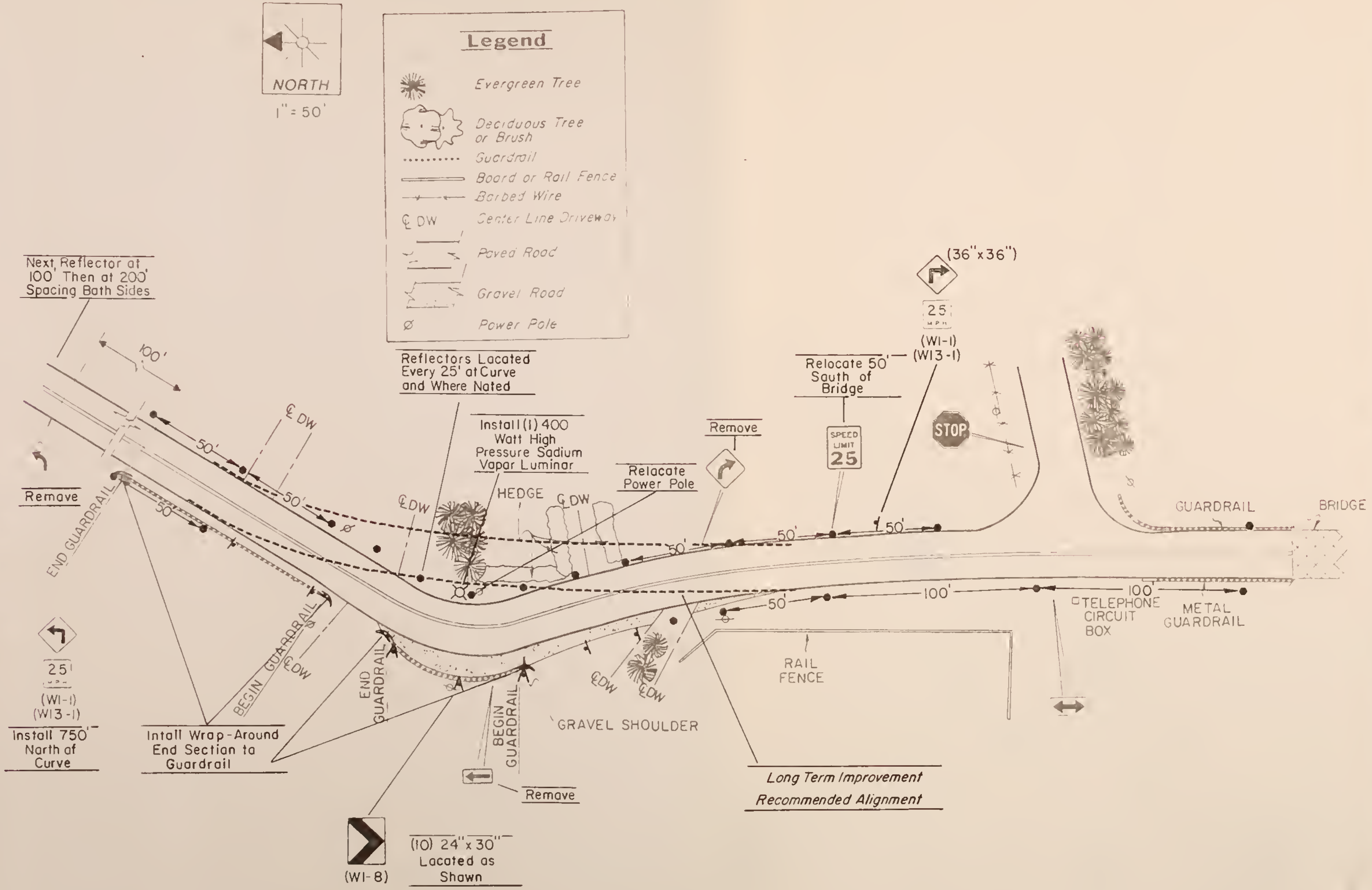
SYMBOLS

- VEHICLE PATH
- PEDESTRIAN PATH
- BACKING VEHICLE
- PARKED VEHICLE
- □ FIXED OBJECT
- ● FATAL ACCIDENT
- ○ INJURY ACCIDENT

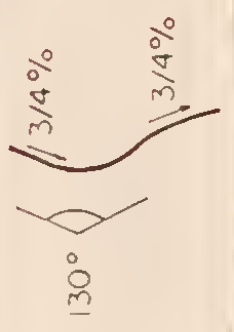
FIGURE NO. 9A

South Whitefish
Stage Road

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

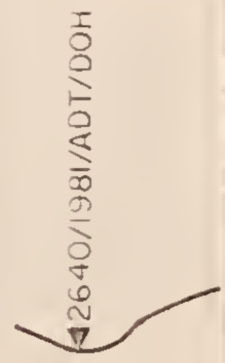


FIGURE NO. 9B

South Whitefish
Stage Road

SITE 10

SITE NUMBER 10

WEST COTTONWOOD DRIVE

A. Location:

Site 10 consists of a .35-mile-long section of West Cottonwood Drive, which originates near the junction of LaSalle Road and U.S. Highway 2. The road primarily serves a moderately developed residential area and provides access to a large mobile home court.

B. Existing Conditions:

Site 10 is composed of a series of mild reverse curves with uniform and flat grades. The roadway has an asphalt surface which varies in width from 19 to 21 feet and has no pavement markings. The posted advisory speed is 25 mph, and several warning and directional signs are located within the section of roadway evaluated. The exact types and locations of signs along this section of West Cottonwood Drive are depicted in Figure 10A. Sight distances are occasionally limited by the degree of curvature and roadside vegetation, but in most cases, obstructions are more than six feet from the edge of the roadway.

Based on machine counts of 24-hour traffic volumes conducted by Robert Peccia and Associates, it was determined the 1981 ADT for this section of roadway is 548 vehicles per day.

C. Accident History:

Although there were no accidents reported during the three-year study period, local residents indicated a history of non-reported, single-vehicle accidents in which the motorist failed to properly identify the road alignment in the dark and left the road. According to the residents, most of the accidents occur at night and involve drinking and reckless driving.

D. Recommendations:

The alignment of this winding residential road presents a problem to the nighttime motorist. In addition, there is no street illumination and the roadway is poorly signed.

The following improvements are recommended in an effort to better guide the motorist through Cottonwood Drive:

1. Install a double solid centerline stripe for the entire length of Cottonwood Drive.
2. Stripe the "T" intersection on the east end of the project to give preference to the traffic on Cottonwood.
3. Install a yield sign (R1-2) on the dead end road to the trailer court.
4. Place curve warning signs (W1-1) on the south and west approaches. Locate one warning sign 300 feet back on the south approach and

the other warning sign 300 feet back on the west approach. The 300-foot setback distances are recommended due to the characteristics of this site.

5. Install "T" intersection warning signs (W2-2) on Cottonwood Drive 300 feet from the Birch Trailer Court on both approaches.

6. Clear and grub the right-of-way directly across from the Birch Trailer Court back to the right-of-way limits. This will include cutting approximately 25 six-inch maximum diameter trees.

7. Install curve warning signs (W1-2) on Cottonwood Drive to better identify the 60-degree change in alignment in the curve to the west of the Birch Trailer Court entrance. The signs should be placed 300 feet from the curve.

8. Remove existing double directional arrow (W1-7) and replace it with a single directional arrow (W1-6).

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
4000	lf	Paint Striping - 4" solid	$0.04/lf	$160.00
1	ea	Install Yield Sign (R1-2) 36" x 36" x 36"	$165/ea	165.00
20	ea	Install Reflectorized Delineator, 4" x 4", Design "F"	$15.50/ea	310.00
2	ea	Install "T" Intersection Warning Sign (W2-2)	$130/ea	260.00
¼	ac	Clear and Grub	$2,000/ac	500.00
4	ea	Install Curve Warning Sign (W1-2) or (W1-1)	$130/ea	520.00
1	ea	Remove Double Directional Arrow (W1-2)	$35/ea	35.00
1	ea	Install Directional Arrow (W1-6)	$163/ea	163.00
TOTAL COST:				$2,113.00

BENEFIT/COST RATIO: 0.00*

* There were no accidents at this site; therefore, the Benefit/Cost Ratio is zero.

East approach on Cottonwood Drive as viewed from the "T" intersection.

West approach to curve on Cottonwood Drive looking from the east.

DETERMINATION OF HAZARD INDEX

Site Number 10 Date November, 1981

Site Description West Cottonwood Drive

Indicator	Data Value		Indicator Value	Weight		Partial H.I.'s
Number of Accidents	0	acc/yr	0	x 0.164	=	0
Accident Rate	0	acc/MVE	0	x 0.225	=	0
Accident Severity	0	dollars	0	x 0.191	=	0
Volume/Capacity Ratio	0.12		29	x 0.082	=	2.38
Sight Distance Ratio	0.83	(wt. avg.)	48	x 0.074	=	3.55
Driver Expectancy	3.5	(wt. avg.)	58	x 0.149	=	8.64
Information System Deficiencies	5.0	(wt. avg.)	83	x 0.115	=	9.55

Hazard Index: 24.12

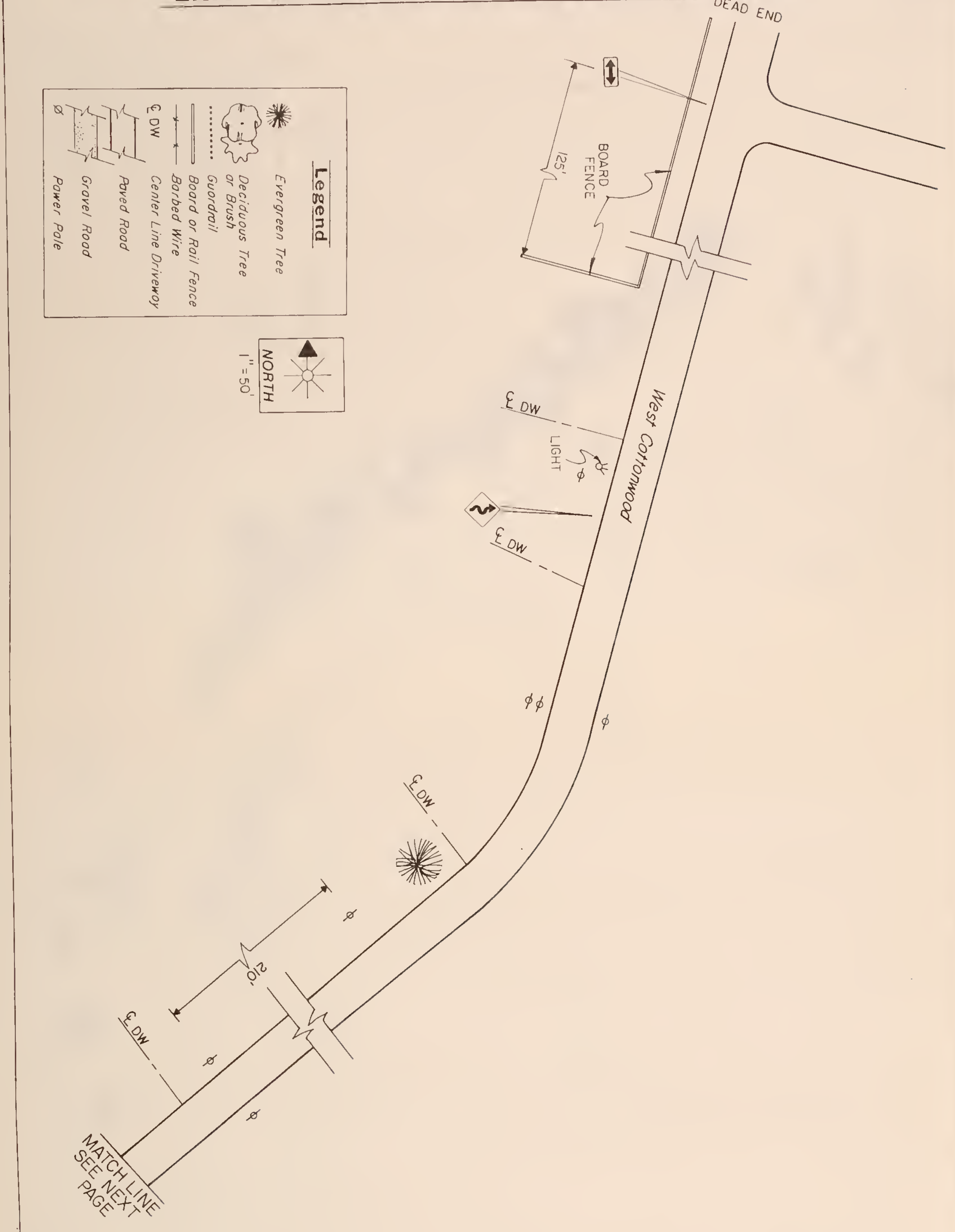
Cost of Recommended Improvements: $2,113.00

Cost Factor: 96

Priority Index = Hazard Index x .75 + Cost Factor x .25

24.12 x .75 + 96 x .25 = 42.09

EXISTING CONDITIONS & COLLISION DIAGRAM



SYMBOLS

- VEHICLE PATH
- PEDESTRIAN PATH
- BACKING VEHICLE
- PARKED VEHICLE
- □ FIXED OBJECT
- ● FATAL ACCIDENT
- ○ INJURY ACCIDENT

COLLISION TYPES

- REAR END
- HEAD ON
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- ANGLE

CONDITIONS

WEATHER:
F=Fog C=Clear R=Rain
S=Snow SL=Sleet

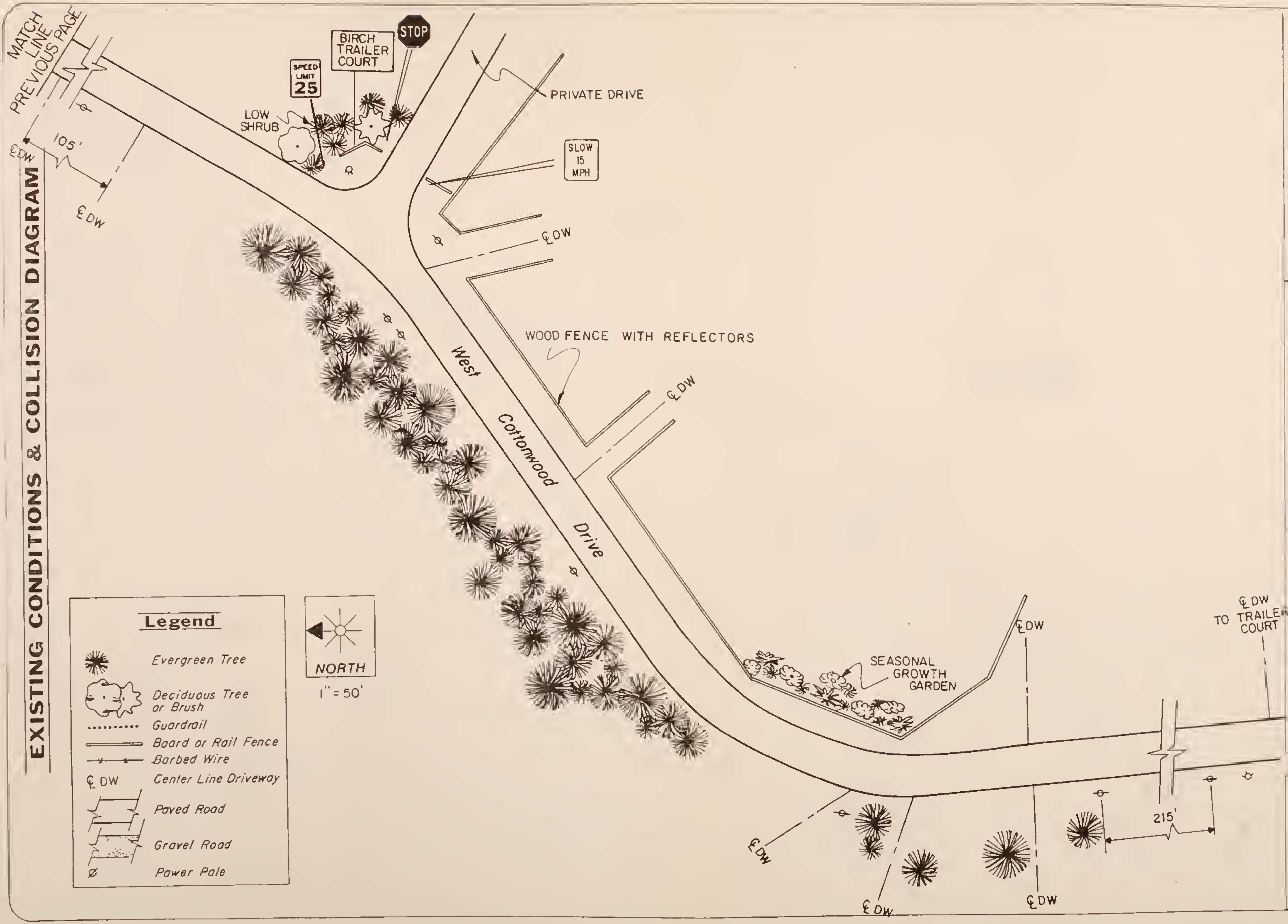
PAVEMENT: D=Dry W=Wet I=Icy

TIME — 1400 7-05-75 — DATE
WEATHER — C. D. DAY — LIGHT
PAVEMENT

FIGURE NO. 10A

West Cottonwood
Drive

EXISTING CONDITIONS & COLLISION DIAGRAM



CONDITIONS

WEATHER: F=Fog C=Clear R=Rain S=Snow SL=Sleet I=Icy

PAVEMENT: D=Dry W=Wet

TIME 1400
DATE 7-05-75
WEATHER C.
LIGHT DAY
PAVEMENT D.

COLLISION TYPES

REAR END
HEAD ON
SIDE SWIPE
OUT OF CONTROL
LEFT TURN
ANGLE

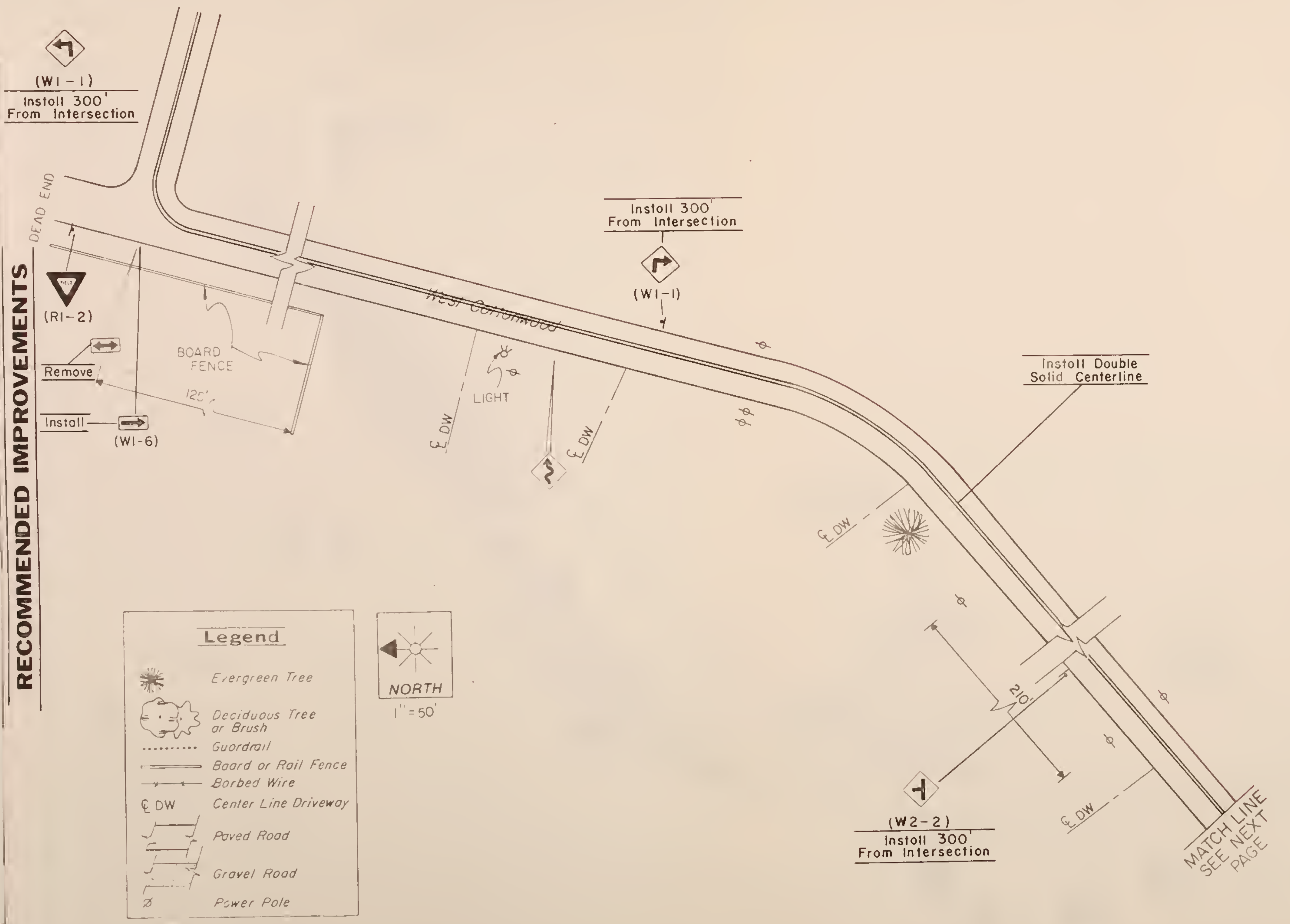
SYMBOLS

VEHICLE PATH
PEDESTRIAN PATH
BACKING VEHICLE
PARKED VEHICLE
FIXED OBJECT □
FATAL ACCIDENT ●
INJURY ACCIDENT ○

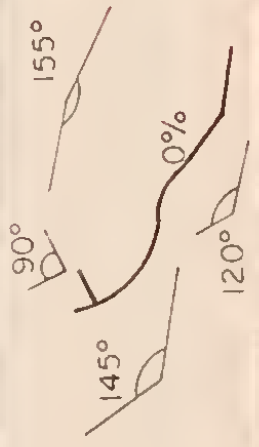
FIGURE NO. 10A
(CONT.)

West Cottonwood Drive

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

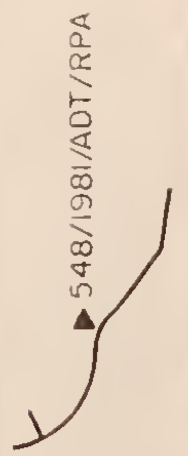
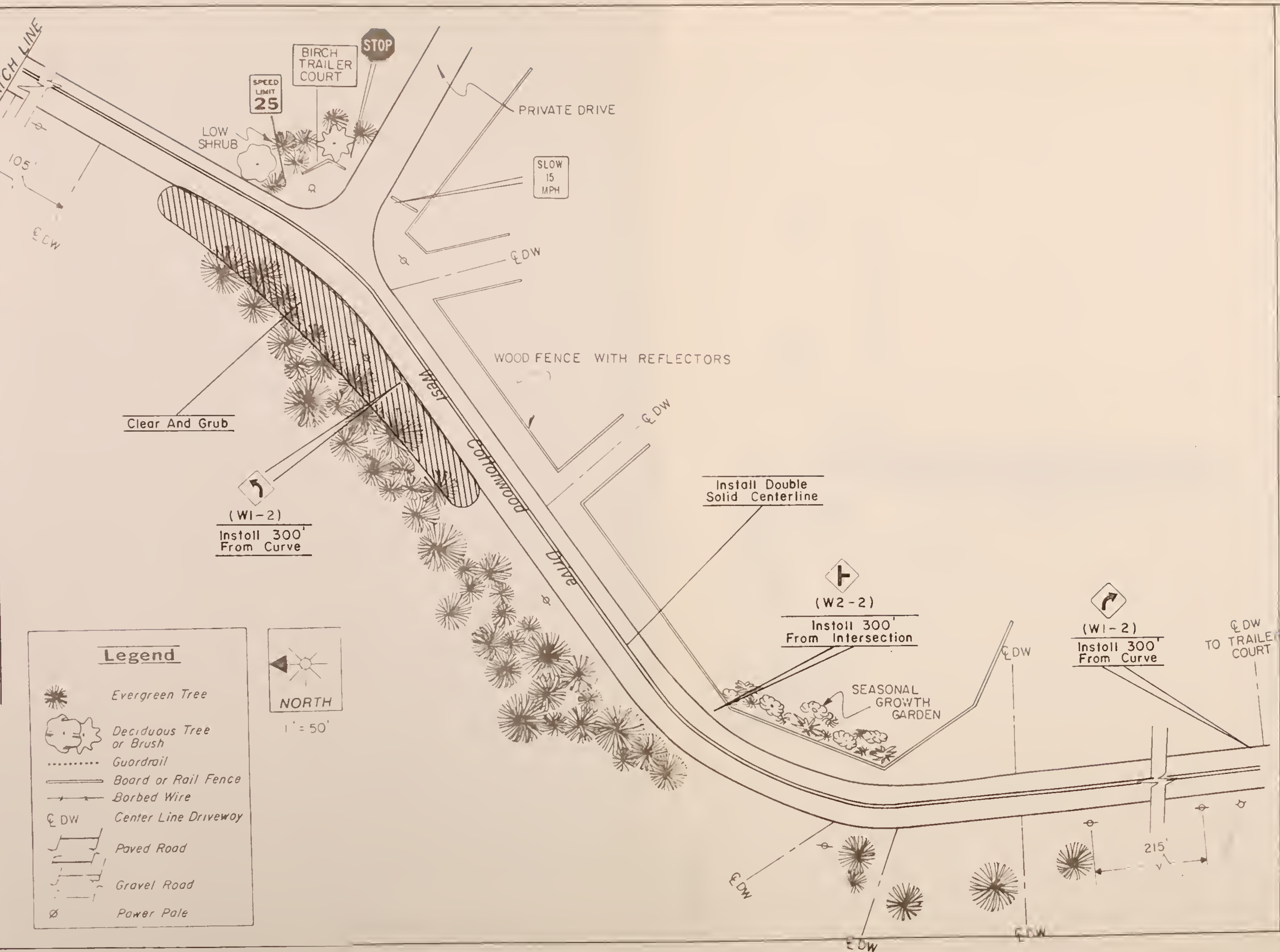


FIGURE NO. 10B

West Cottonwood
Drive

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS

EXISTING TRAFFIC VOLUMES

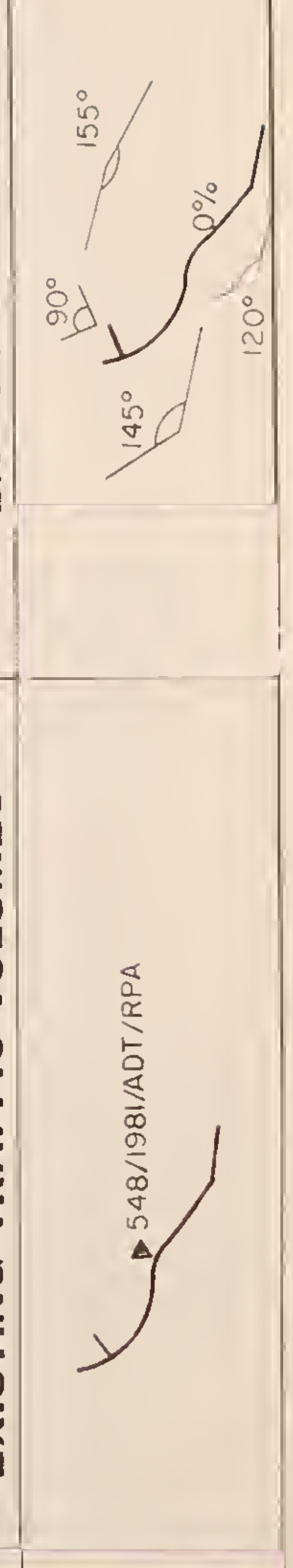


FIGURE NO. 10B
(CONT.)

West Cottonwood Drive

SITE 11

SITE NUMBER 11

INTERSECTION OF HELENA FLATS ROAD (FAU 6712) AND EAST EVERGREEN DRIVE

A. Location:

Site 11 includes the intersection of Helena Flats Road with East Evergreen Road and is located one block north of U.S. Highway 2 about two miles east of the Kalispell city limits. Helena Flats Road and the west leg of the intersection serve primarily through traffic, while the east leg provides access to a residential area composed primarily of mobile homes.

B. Existing Conditions:

Helena Flats Road and East Evergreen Drive are asphalt-surfaced roadways approximately 22 feet wide, with uniform, flat grades through the entire site. The east and west legs of the intersection are offset approximately ten feet. There are no pavement markings delineating driving lanes or shoulders; however, a pedestrian crosswalk and stop bars are painted on the north and south legs of the intersection. Advance "Pedestrian Crossing" warning signs are located on the north and south approaches to the site. The posted speed limit is 25 mph through the intersection, and the east and west approaches to the intersection are regulated by stop signs. The stop sign on the west approach is obscured by several large evergreen trees and is difficult to see at night at a distance of more than 200 feet. These evergreen trees also limit the sight distance of drivers wishing to enter the intersection from the western approach. Figure 11A depicts the existing site conditions, and Plate 11 emphasizes the sight distance limitations of the west leg of the intersection.

Twenty-four hour machine counts of traffic volumes and peak hour turning movements were collected by the Montana Department of Highways and Robert Peccia and Associates. Based on this data, 1981 ADTs were determined for all legs of the intersection. The average daily traffic was estimated to be 1,200 and 1,829 vehicles per day, respectively, for the north and south legs of the intersection. Traffic on East Evergreen Drive was determined to be 520 vehicles per day for the west leg and 200 vehicles per day for the east leg. Pedestrian traffic is primarily made up of children who must cross Helena Flats Road to attend school.

C. Accident History:

One accident was reported at this location during the three-year study period. The accident occurred when the motorist lost control of the vehicle, went off the right side of Helena Flats Road, and struck a tree, with no injuries resulting. The accident rate at this location is 0.5 accidents per million vehicles entering. There was evidence of another unreported accident in the form of a damaged fence on the northeast corner of the intersection.

It appears that a vehicle probably failed to stop on the west approach and slid across the intersection, hitting the fence. Since the collection of the accident data used in this report, a fatality occurred at this location involving a child on a bicycle.

D. Recommendations:

The sight distance is impaired on the west and south approaches by the adjacent trees, and the stop sign on the west approach is not clearly visible because of tree branches. The west approach is a very long tangent section, but the intersection is not easily identified on the approach. The north and east approaches are well marked and the intersection is visible well in advance.

The following recommended improvements are primarily intended to improve the south and west approaches:

1. Install solid double centerline striping on Helena Flats beginning at the intersection with U.S. 2 and extending north to a point 500 feet from the intersection. Similarly stripe 500 feet of the west approach.
2. Install painted stop bars on both the east and west approaches.
3. Remove all visual obstructions (trees, branches, shrubs, etc.) on the west approach that block the motorist's vision of the stop sign. The sign should be clearly visible for at least 500 feet.
4. Install crossroad warning signs (W2-1) 750 feet from the intersection on the north and south approaches.
5. Clear and grub the west side of the south approach back to the limits of the right-of-way. The growth of small trees and shrubs reduces the sight distance on the bend south of the intersection.
6. It is recommended that the county continue their efforts to remove or trim the spruce trees on the southwest corner. These trees greatly reduce the drivers' ability to safely negotiate the intersection.
7. Install a stop ahead warning sign (W3-1) 750 feet from the intersection on the west approach.

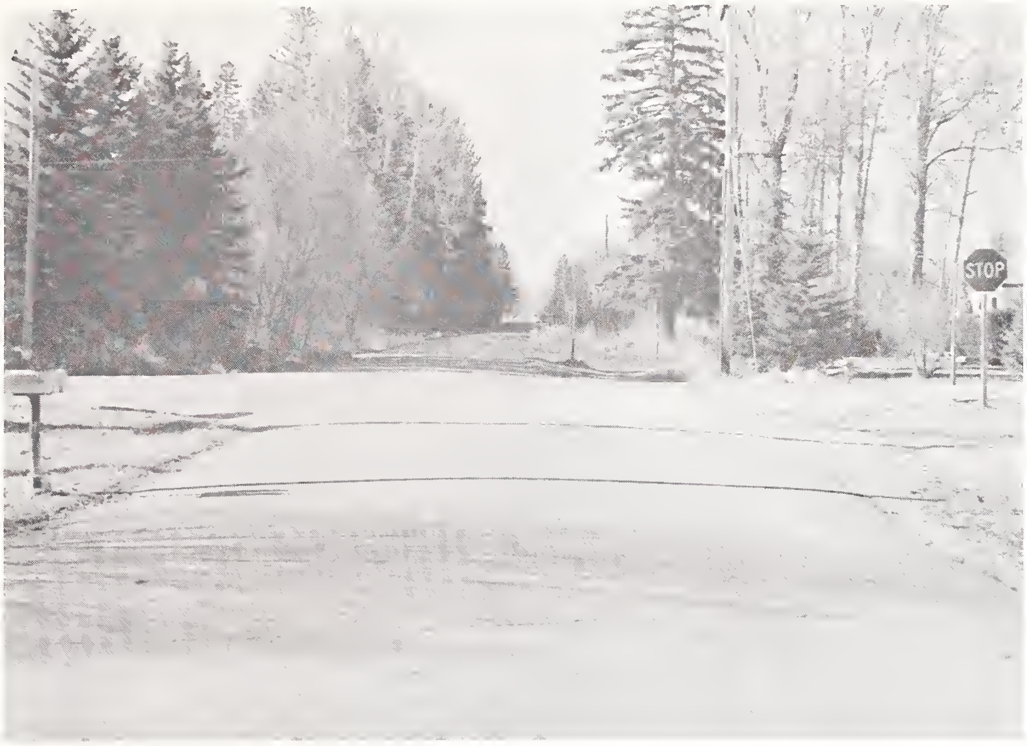
Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
3600	lf	Paint Striping 4" Wide - Solid	$0.04/lf	$ 144.00
2	ea	Install Stop Bar	$20/ea	40.00
1	ea	Cut and Prune Trees,	Lump Sum	440.00
¼	ac	Clear and Grub	$2,000/ac	500.00
2	ea	Install Crossroad Warning Sign (W2-1)	$130/ea	260.00

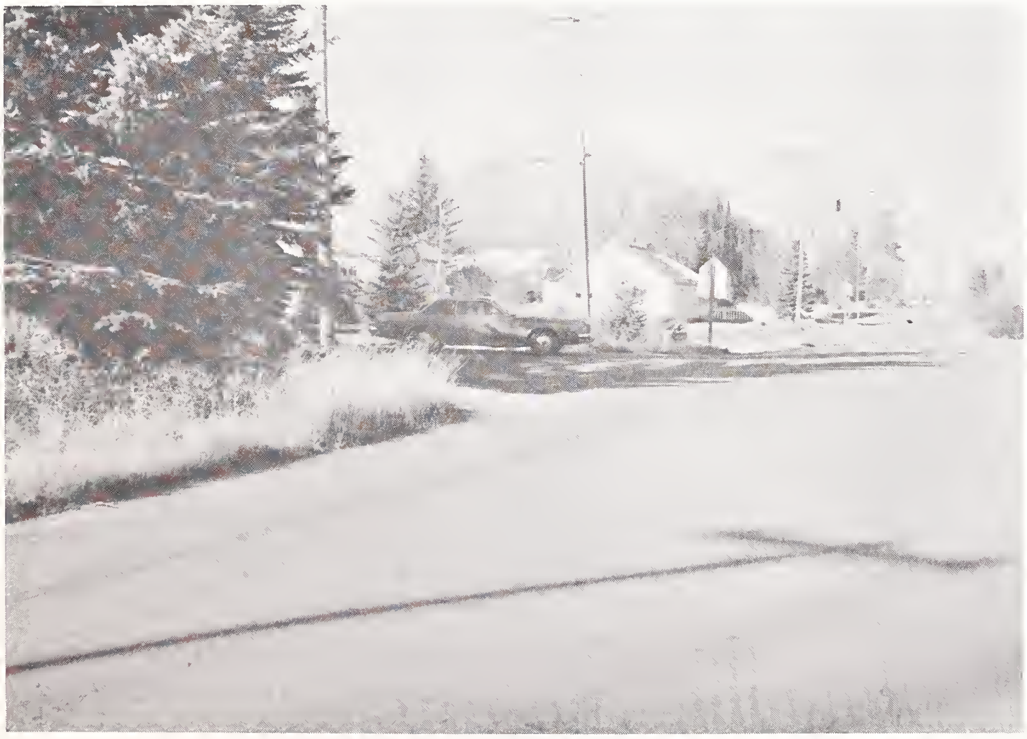
Improvement Cost Estimate
(cont.)

Quantity	Unit	Item Description	Unit Price	Total Price
1	ea	Install Stop Ahead Warning Sign (W3-1)	$130/ea	130.00
1	ea	Relocate Stop Sign	$60/ea	60.00
TOTAL COST:				$1,574.00

BENEFIT/COST RATIO: 0.18



View of the intersection from the east approach. Note that the stop sign for the west approach (shown at the left side of the photo) is partially obscured by branches.



View of the west approach as seen from the south. Note the trees at the left blocking sight distance of the west approach.

ACCIDENT DATA

INTERSECTION OF HELENA FLATS ROAD (FAU 6712) AND EVERGREEN DRIVE (FAU 6710)

SITE NUMBER 11 *ACCIDENT PERIOD* 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
0	1	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
				1		

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
				1							

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
															1								

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
1			

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
1				

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
1			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
			1						

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

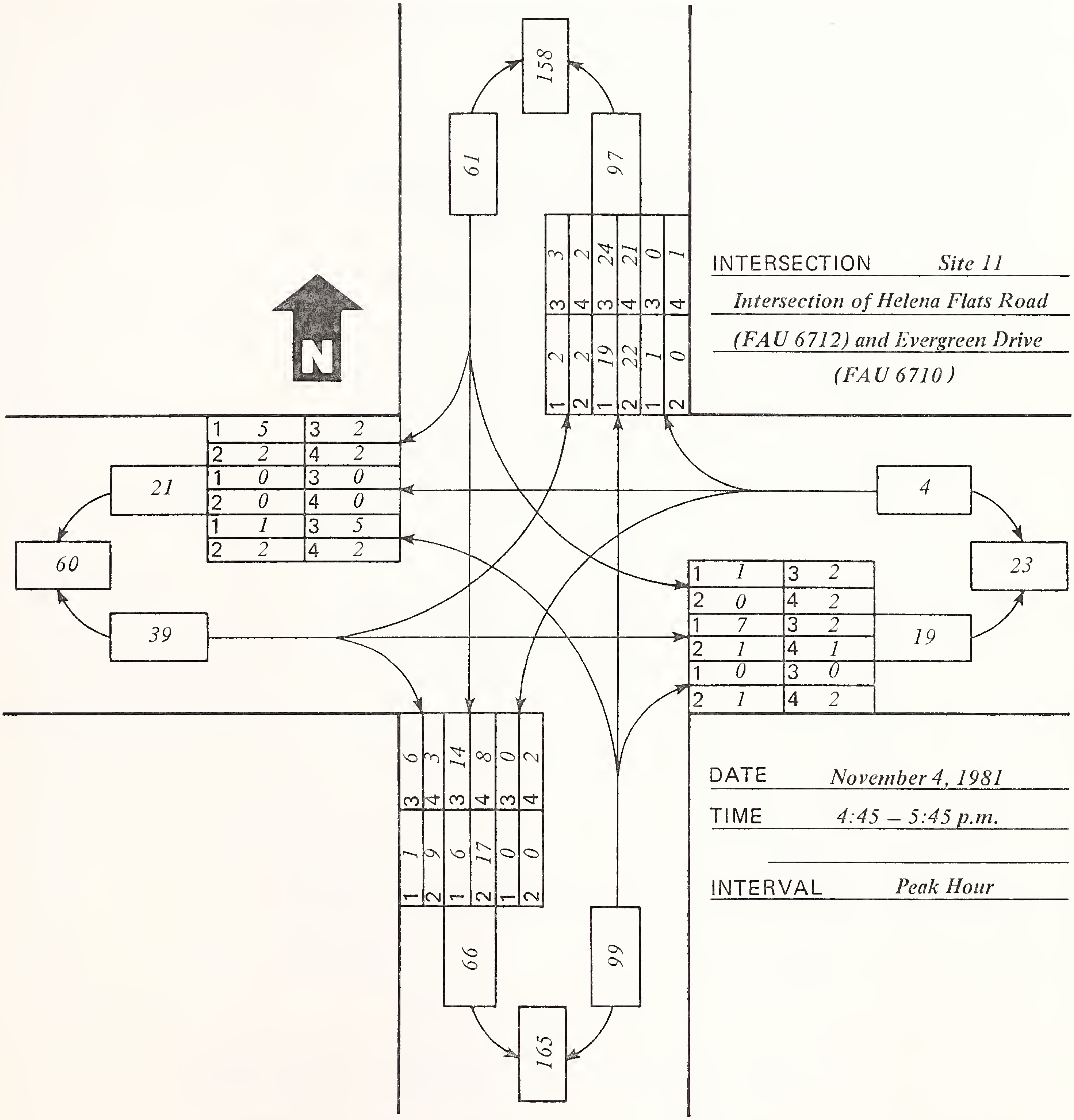
No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
			1					

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	0	0	0
Fatality	0	0	0
Property Dam. Only	0	1	0

Robert Peccia & Associates

TURNING MOVEMENTS



INTERSECTION *Site 11*

Intersection of Helena Flats Road

(FAU 6712) and Evergreen Drive

(FAU 6710)

DATE *November 4, 1981*

TIME *4:45 – 5:45 p.m.*

INTERVAL *Peak Hour*

Robert Peccia & Associates

DETERMINATION OF HAZARD INDEX

Site Number 11 Date November, 1981

Site Description Intersection of Helena Flats Road (FAU 6712) and Evergreen Drive (FAU 6710)

Indicator	Data Value		Indicator Value	Weight		Partial H.I.'s
Number of Accidents	0.3	acc/yr	13	x 0.164	=	2.13
Accident Rate	0.5	acc/MVE	9	x 0.225	=	2.03
Accident Severity	12,300	dollars	69	x 0.191	=	13.18
Volume/Capacity Ratio	0.04		17	x 0.082	=	1.39
Sight Distance Ratio	0.47	(wt. avg.)	100	x 0.074	=	7.40
Driver Expectancy	4.2	(wt. avg.)	69	x 0.149	=	10.28
Information System Deficiencies	4.2	(wt. avg.)	69	x 0.115	=	7.94

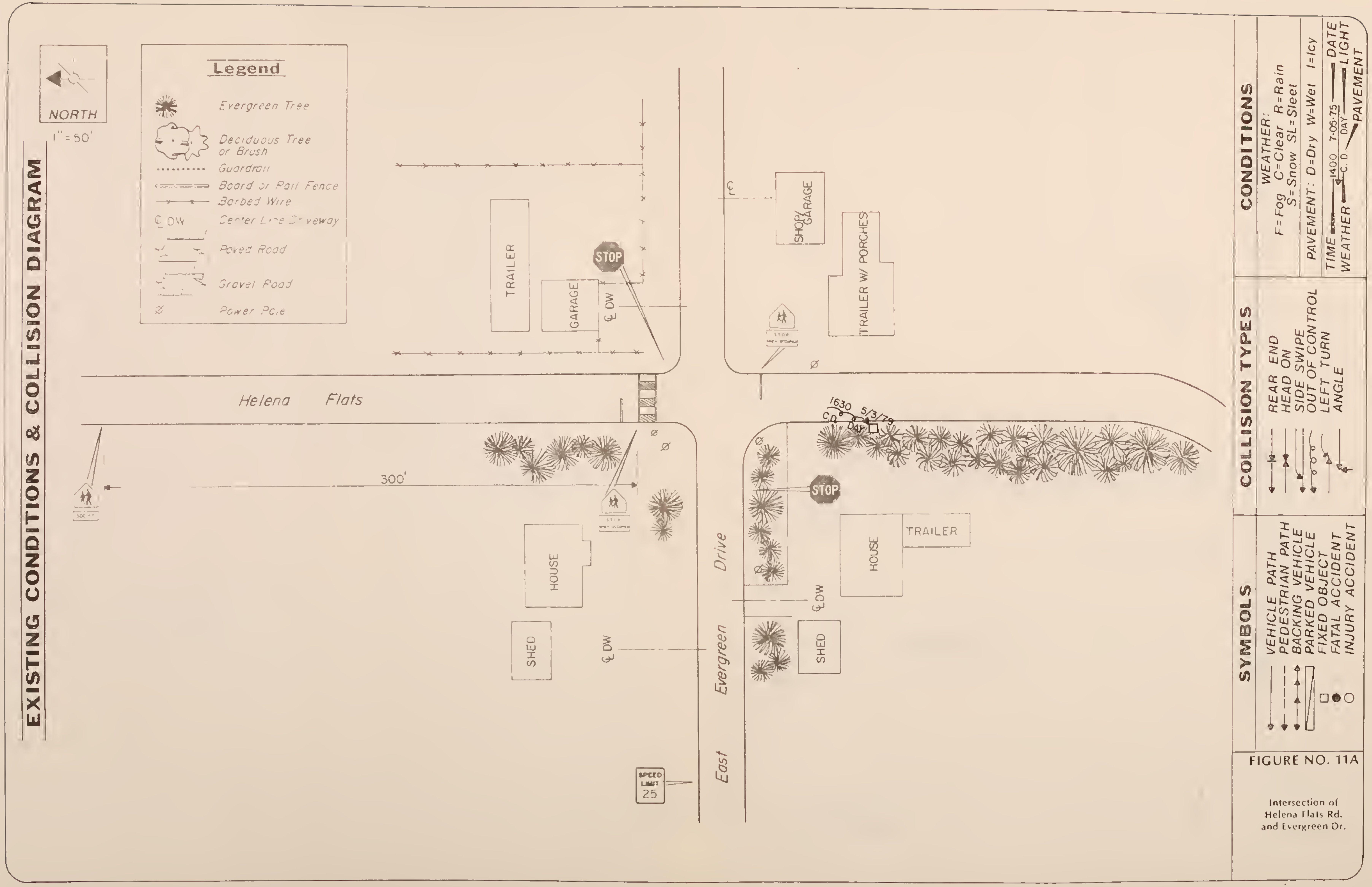
Hazard Index: 44.35

Cost of Recommended Improvements: $1,574.00

Cost Factor: 100

Priority Index = Hazard Index x .75 + Cost Factor x .25

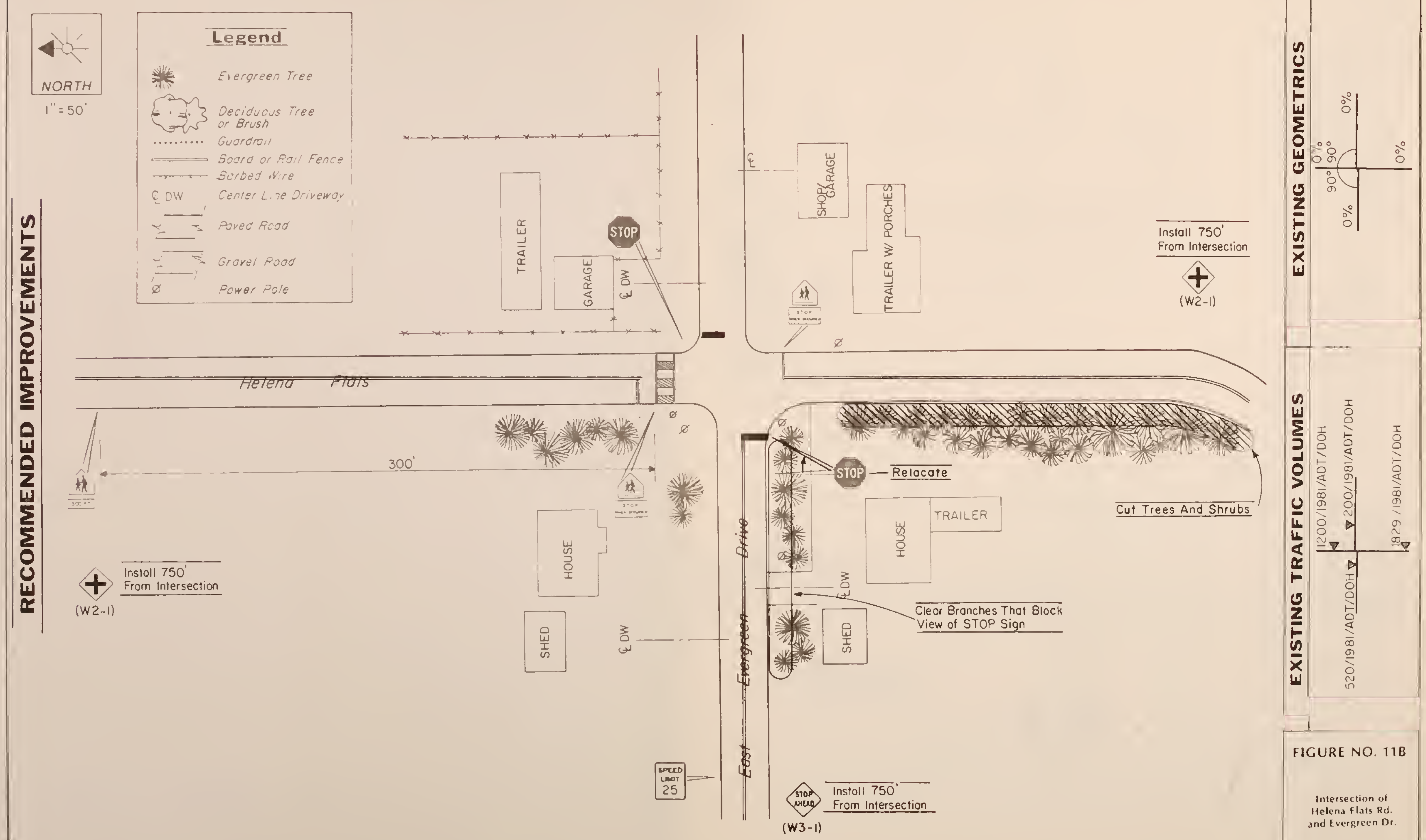
44.35 x .75 + 100 x .25 = 58.26



EXISTING CONDITIONS & COLLISION DIAGRAM

FIGURE NO. 11A

Intersection of Helena Flats Rd. and Evergreen Dr.


RECOMMENDED IMPROVEMENTS

EXISTING GEOMETRICS

EXISTING TRAFFIC VOLUMES

FIGURE NO. 11B

Intersection of
Helena Flats Rd.
and Evergreen Dr.

S
I
T
E
12

SITE NUMBER 12

INTERSECTION OF U.S. 93 (FAP 5) AND WEST RESERVE DRIVE (FAS 548)

A. Location:

Site 12 includes a .4-mile-long segment of West Reserve Drive extending from U.S. 93 to the bridge over the Stillwater River. This site is located approximately 1.5 miles due north of the city of Kalispell in a relatively undeveloped rural area of the Flathead Valley.

B. Existing Conditions:

West Reserve Drive has an asphalt pavement surface that is typically 22 feet wide. This section of road is straight and travels through somewhat rolling terrain. Grades vary from 2.25 to four percent on the west approach to the bridge and 5.5 percent east of the structure. The driving lanes and shoulders are delineated with a double solid centerline and shoulder stripes. A stop sign and a 240-foot-long section of guard rail are located at the intersection with U.S. 93 on the east approach. The posted speed limit for the majority of the section of roadway is 35 mph; however, the speed limit in the vicinity of the bridge is reduced to 25 mph. In addition, object markers have been installed on both bridge approaches. Due to the rolling terrain, the bridge is somewhat hidden from drivers approaching from both directions, especially if the driver is travelling at an excessive speed. Existing conditions are depicted in Figure 12A and Plate 12.

The 1981 ADT for this section of West Reserve Drive was determined to be 1,750 vehicles per day. This figure was derived from 24-hour machine counts of traffic volumes conducted by the Montana Department of Highways. West Reserve Drive serves as a convenient connecting route to residential areas in the east valley and to industrial areas along Whitefish Stage Road or LaSalle Road.

C. Accident History:

Five accidents were reported at this site during the three-year study period. Four of the accidents occurred at the U.S. 93 intersection and one on the Stillwater River Bridge. All of the intersection accidents involved a northbound vehicle on U.S. 93. Injuries occurred in two of the intersection accidents when the vehicles left the road during nighttime driving hours. The accident that occurred at the bridge involved a westbound motorist who lost control of the vehicle on wet pavement on the west bridge approach and left the road, striking a power pole. The accident rate at this site is 0.7 accidents per million vehicles entering.

D. Recommendations:

The entire U.S. 93 and West Reserve intersection is well designed.

There is ample sight distance, nighttime intersection lighting, and good signing and striping of U.S. 93. The West Reserve approaches could be improved by upgrading the existing centerline striping and the stop bars. It should be noted that the Department of Highways has a project programmed that will replace the existing Stillwater River bridge with a new one and improve both bridge approaches. Therefore, only short-term improvements are recommended.

The following improvements are recommended:

1. Install a stop ahead warning sign (W3-1) 750 feet back on both the east and west approaches to the intersection. Painted stop bars should also be installed on these approaches.
2. Install slippery when wet signs and plates (W8-5 and W8-5P) 750 feet from the bridge on both approaches.
3. Install bump signs (W8-1) 250 feet from the ends of the bridge. This warning is given to alert the motorist of the rough grade break at the bridge.
4. Continue and maintain the existing striping through this site.
5. Relocate the 35 mph sign on the south side of the road to six feet from the edge of the travelway. The sign is presently more than 15 feet from the shoulder.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
2	ea	Install Stop Ahead Warning Sign (W3-1)	$130/ea	$260.00
2	ea	Install Stop Bar	$20/ea	40.00
2	ea	Install Slippery When Wet Warning Sign (W8-5) with Advisory Plate (W8-5P), 24" x 18"	$180/ea	360.00
2	ea	Install Bump Warning Sign (W8-1)	$130/ea	260.00
1	ea	Relocate 35 mph Sign (R2-1)	$35/ea	35.00
TOTAL COST:				$955.00

BENEFIT/COST RATIO: 0.36

West Reserve Drive as viewed from the U.S. 93 intersection.

The bridge over the Stillwater River on West Reserve as viewed from the east end.

ACCIDENT DATA

INTERSECTION OF U.S. 93 (FAP 5) AND WEST RESERVE DRIVE (FAS 548)

SITE NUMBER 12 *ACCIDENT PERIOD* 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
2	0	3

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
2		2			1	

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
2				1	1					1	

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
	2										1							1	1				

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Daylight	*Dark*	*Dawn*	*Dusk*
2	3		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
1	3		1	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
4	1		

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Sideswipe*	*Non-Col*	*Head-on*	*Backing*
1		1	1				2		

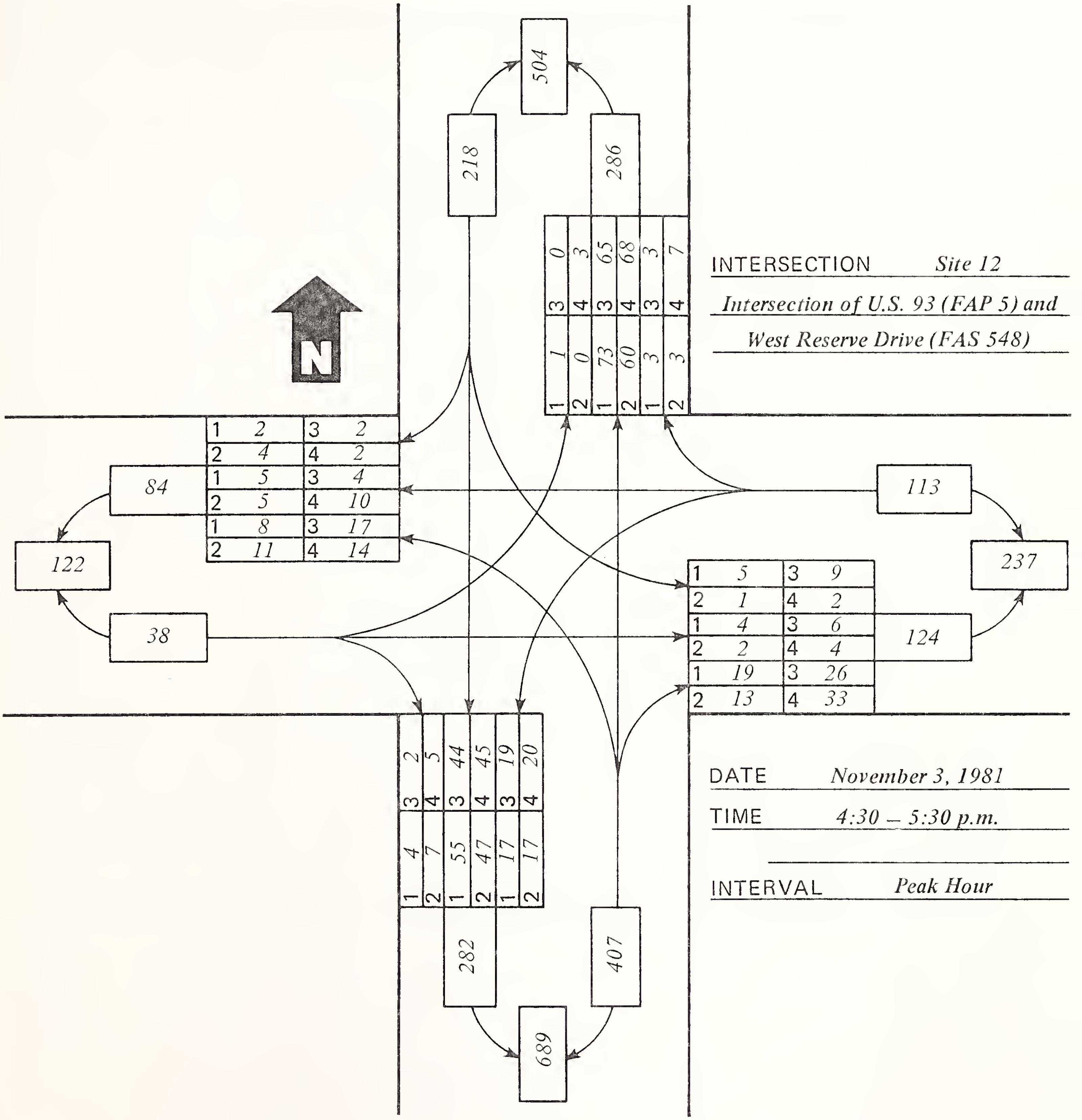
NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
2	1		1				1	

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	0	0	2
Fatality	0	0	0
Property Dam. Only	2	0	1

TURNING MOVEMENTS



INTERSECTION *Site 12*

Intersection of U.S. 93 (FAP 5) and

West Reserve Drive (FAS 548)

DATE *November 3, 1981*

TIME *4:30 – 5:30 p.m.*

INTERVAL *Peak Hour*

RPA Robert Peccia & Associates

DETERMINATION OF HAZARD INDEX

Site Number 12 Date November, 1981

Site Description Intersection of U.S. 93 (FAP 5) and West Reserve Drive (FAS 548)

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	1.7 acc/yr	34	x 0.164 =	5.58
Accident Rate	0.7 acc/MVE	13	x 0.225 =	2.93
Accident Severity	10,920 dollars	66	x 0.191 =	12.61
Volume/Capacity Ratio	0.10	27	x 0.082 =	2.21
Sight Distance Ratio	1.14 (wt. avg.)	27	x 0.074 =	2.00
Driver Expectancy	3.3 (wt. avg.)	56	x 0.149 =	8.34
Information System Deficiencies	3.8 (wt. avg.)	64	x 0.115 =	7.36

Hazard Index: 41.03

Cost of Recommended Improvements: $955.00

Cost Factor: 100

Priority Index = Hazard Index x .75 + Cost Factor x .25

41.03 x .75 + 100 x .25 = 55.77

EXISTING CONDITIONS & COLLISION DIAGRAM

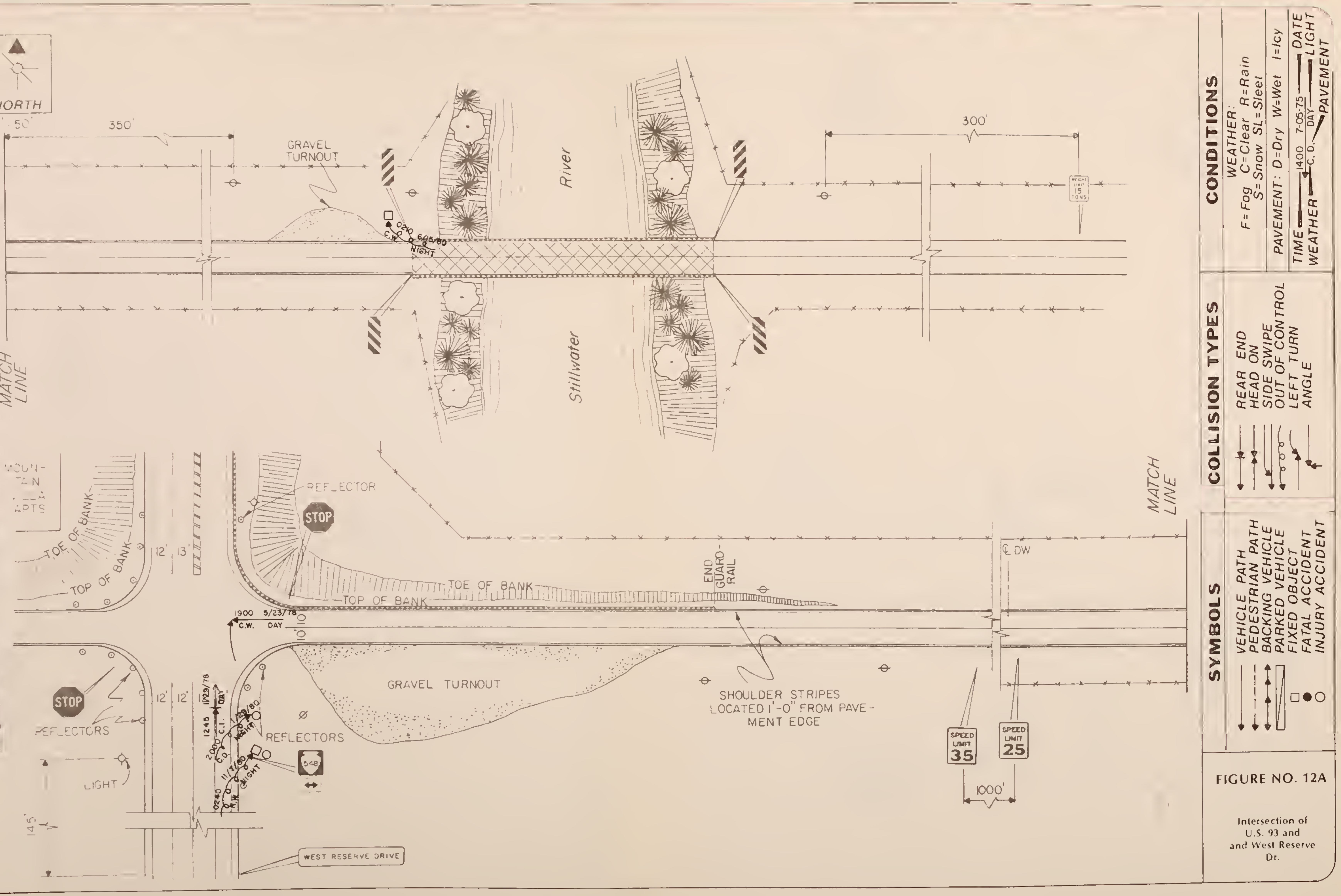


FIGURE NO. 12A

Intersection of
U.S. 93 and
and West Reserve
Dr.

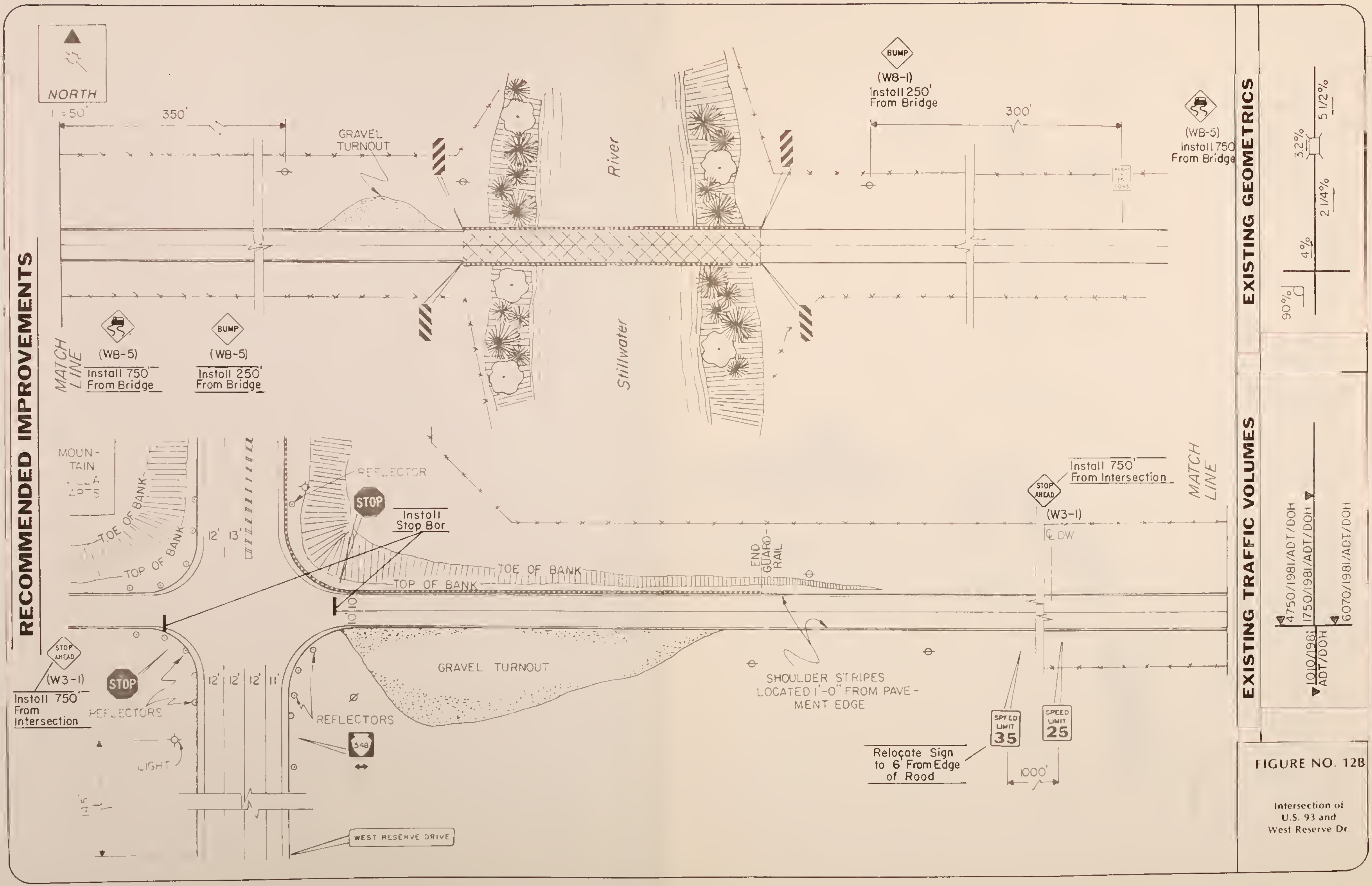


FIGURE NO. 12B

Intersection of U.S. 93 and West Reserve Dr.

S
I
T
E
13

SITE NUMBER 13

WEST RESERVE DRIVE (FAS 548)

A. Location:

Site 13 is located approximately .5 miles east of the intersection of Whitefish Stage Road and West Reserve Drive. The site is located northeast of the city limits of Kalispell in a rural portion of the Flathead Valley.

B. Existing Conditions:

Site 13 consists of a ten percent grade approximately 800 feet in length followed by a sharp curve at the bottom of the grade. The roadway surface is asphalt pavement and is typically 22 feet wide. The section is flanked on the north by a steep road cut and on the south by a steep, tree-lined bank which drops off toward the Whitefish River. The roadway is striped with a double yellow centerline and white shoulder stripes for the entire length of the section. The "Narrow Hill" and "Watch for Ice" warning signs that presently exist on both approaches to the site are not conventional warning signs. The posted speed for this section of West Reserve Drive is 25 mph. Trees located on the north side of the road are within six feet of the edge of the pavement and constitute obstructions, as well as limiting sight distance. A residential driveway is located midway down the hill and sight distance is extremely limited for drivers attempting to enter onto West Reserve Drive. Figure 13A and Plate 13 depict the existing conditions of the site.

The 1981 ADT is estimated to be 1,600 vehicles per day. The route provides a convenient link between LaSalle Road and Whitefish Stage Road.

C. Accident History:

There were seven reported accidents at this site. Six of the seven occurred during clear and daylight conditions. Two injury accidents occurred as a result of the vehicles leaving the road and striking trees. The accident rate at this location is 4.3 accidents per million vehicles entering.

D. Recommendations:

This steep section of road is made hazardous by the minor curves and the trees close to the side of the travelway. This section of road could be made safer if the sight distance were improved by removing the trees on the north side. The Department of Highways has a project programmed that will completely realign this hill; therefore, only short-term improvements are recommended. They are as follows:

1. Remove the existing "narrow hill" sign on the west approach and install a standard hill sign (W7-1), with a supplemental plate (W7-3)

indicating "10% Grade", 750 feet from the top of the hill. The "narrow hill" sign on the east approach should be removed.

2. The "watch for ice" sign at the top of the hill should be changed to an "icy road" sign (W8-10). Because of the seasonal nature of this sign, it should be a hinged panel sign so that it can be folded down during the summer months when it does not apply.

3. The trees on the north side of the road are the only objects that prevent a vehicle from plummeting down the side of the hill, but these trees also reduce the sight distance. Therefore, it is recommended to prune back all limbs and brush that block a clear view of the road ahead.

4. All trees on the inside of the curve at the bottom of the hill should be removed back to the limits of the right-of-way.

5. Install a curve warning sign (W1-1) 750 feet west of the curve at the bottom of the hill. A similar curve warning sign should be placed 300 feet from the curve on the east approach. The setback distance of the sign on this approach is limited by the location of the bridge. A vehicle equipped with a ball bank indicator was used to determine that 25 mph is the safe speed for traveling through the curve. Since the posted speed limit for this section of road is 25 mph, no advisory speed is necessary.

6. Install direction arrows (W1-6) on the curve at the bottom in such a fashion that they can be clearly seen for at least 500 feet on both approaches.

7. Install reflectorized delineators (4" x 4" Design "C") on the outside of the curve at the bottom of the hill as indicated on Figure 13B.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
1	ea	Remove Sign - Single Pole	$60/ea	$ 60.00
1	ea	Install Hill Sign (W7-1) and Grade Plate (W7-3), 24" x 18"	$180/ea	180.00
2	ea	Install Directional Arrow (W1-6)	$163/ea	326.00
1	ea	Install Curve Warning Sign (W1-1)	$130/ea	130.00
1	ea	Prune Trees	Lump Sum	500.00
10	ea	Cut Trees 6" Max. Dia.	$25/ea	250.00

Improvement Cost Estimate
(cont.)

Quantity	Unit	Item Description	Unit Price	Total Price
14	ea	Install Reflectorized Delineator, 4" x 4", Design "C"	$18/ea	252.00
1	ea	Install Icy Road Warning Sign (W8-10)	$130/ea	130.00

TOTAL COST: $1,828.00

BENEFIT/COST RATIO: 2.37

View of the West Reserve Hill from the top. Note proximity of trees and shrubs to the edge of the roadway.

View of the curve at the bottom of the hill from the west.

ACCIDENT DATA

WEST RESERVE DRIVE (FAS 548)

SITE NUMBER 13 ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
3	4	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
	1		2	1	2	1

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					1			3	1	2	

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1								1			1			2		1		1					

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Daylight	Dark	Dawn	Dusk
6	1		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
4	1		2	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
7			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
			3			1	3		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
2		1	4					

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	1	0	0
Fatality	0	0	0
Property Dam. Only	2	3	0

DETERMINATION OF HAZARD INDEX

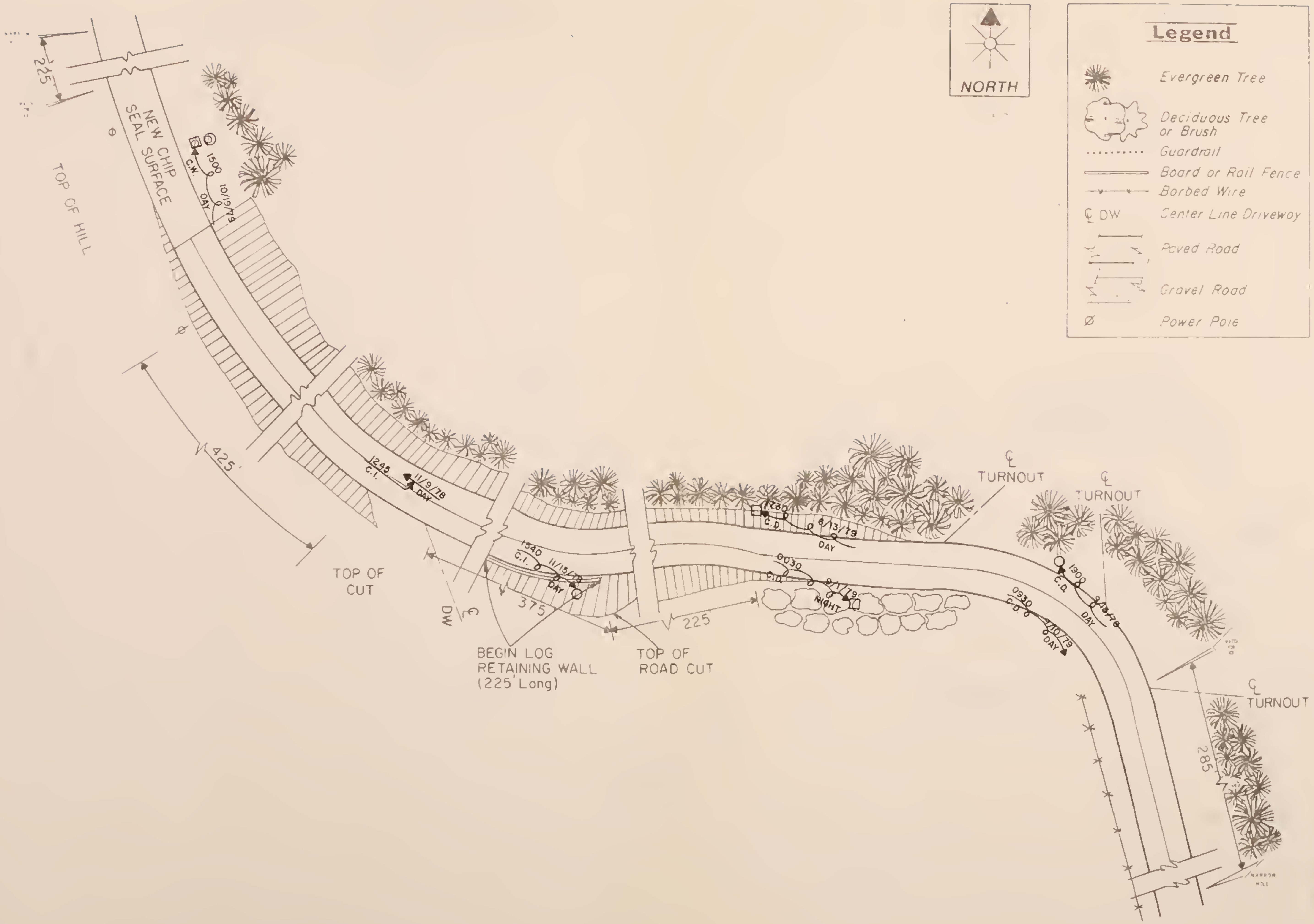
Site Number 13 Date No

Site Description West Reserve Drive (FAS 5

Indicator	Data Value		Indicator Value
Number of Accidents	2.3	acc/yr	40
Accident Rate	4.3	acc/MVE	61
Accident Severity	11,043	dollars	66
Volume/Capacity Ratio	0.71		100
Sight Distance Ratio	0.55	(wt. avg.)	90
Driver Expectancy	2.5	(wt. avg.)	42
Information System Deficiencies	3.5	(wt. avg.)	58

Hazard Index:

EXISTING CONDITIONS & COLLISION DIAGRAM



CONDITIONS

WEATHER: F=Fog C=Clear R=Rain S=Snow SL=Sleet

PAVEMENT: D=Dry W=Wet I=Icy

TIME 1400 — WEATHER C.D — 7-05-75 DATE — DAY LIGHT — PAVEMENT

COLLISION TYPES

- REAR END
- HEAD ON
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- ANGLE

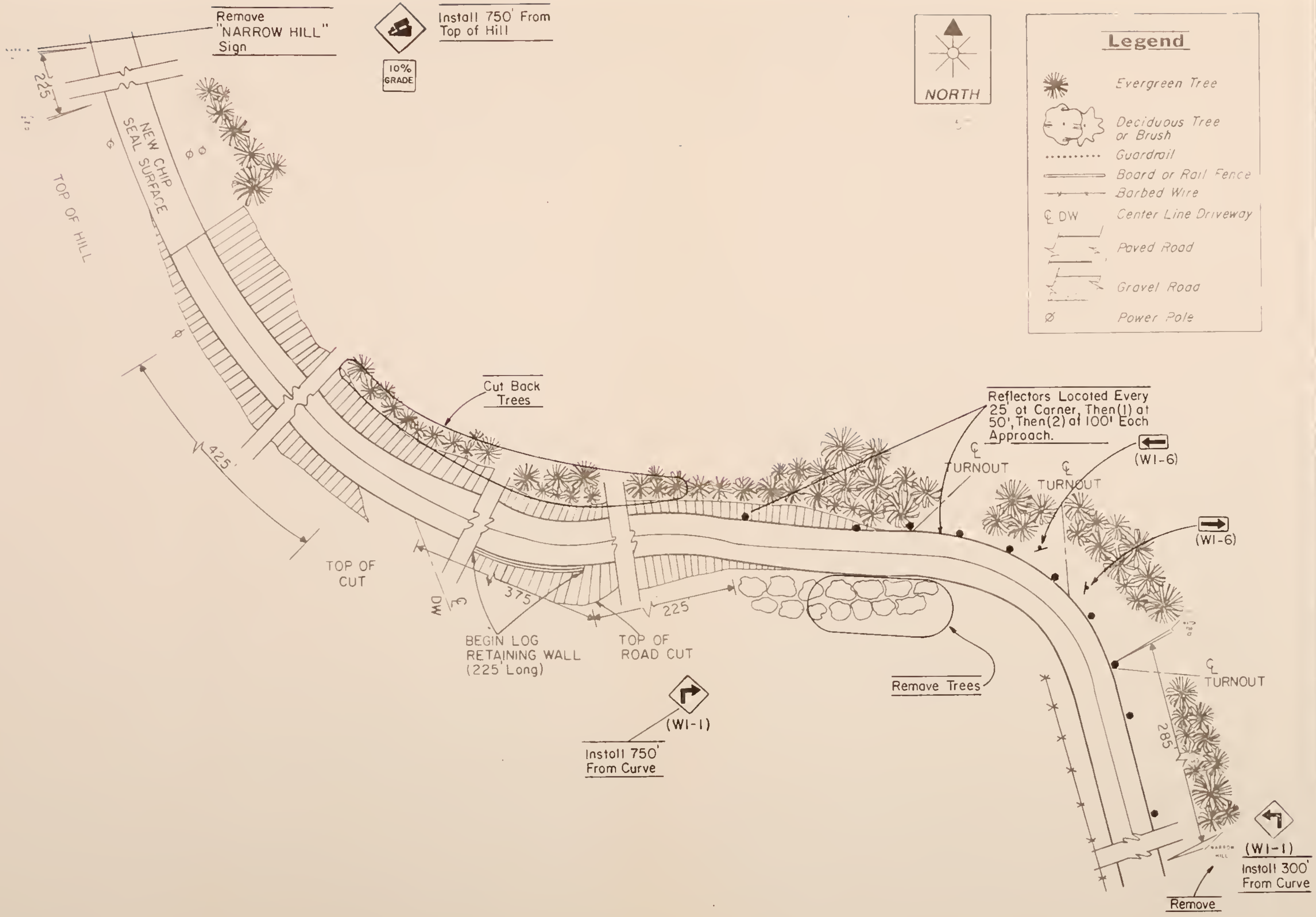
SYMBOLS

- VEHICLE PATH
- PEDESTRIAN PATH
- BACKING VEHICLE
- PARKED VEHICLE
- □ FIXED OBJECT
- ● FATAL ACCIDENT
- ○ INJURY ACCIDENT

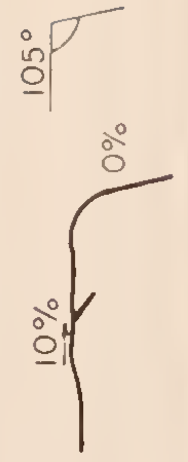
FIGURE NO. 13A

West Reserve Drive

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

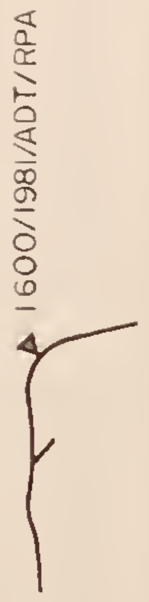


FIGURE NO. 13B

West Reserve Drive

S
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14

SITE NUMBER 14

NORTH WHITEFISH STAGE ROAD

A. Location:

Site 14 includes two reverse curves on North Whitefish Stage Road approximately 8.5 miles north of Kalispell. The site is located in a moderately developed rural area of the Flathead Valley.

B. Existing Conditions:

The asphalt pavement surface of North Whitefish Stage Road is typically 28 feet wide through the site. The rolling terrain in which the roadway is located results in grades varying from 1.75 percent to 2.5 percent. The driving lanes and shoulders are delineated by a double solid centerline and shoulder stripes. Warning signs present in the section include "School Bus Stop" and "Cattle Xing" signs. Curve warning signs with 35 mph advisory speed plates are also located in advance on the north and south approaches. The combination of grades, curves, and vegetation limits sight distance through the site. The lack of sight distance coupled with several driveways and a school bus turnout on the west side of the road make the roadway section quite hazardous. Existing conditions are depicted in Figure 14A and Plate 14.

Based on traffic counts conducted by Robert Peccia and Associates, the 1981 ADT was determined to be 509 vehicles per day. The route provides a convenient north-south connection between the North Flathead Valley and the City of Kalispell.

C. Accident History:

Ten accidents were reported at this location. All were single-vehicle accidents resulting from the vehicles skidding off the road in the area of the reverse curves on North Whitefish Stage Road. In eight of the ten cases, the conditions were clear weather and dry pavement. Five of the accidents occurred during nighttime hours. The accident rate at this location is 19.1 accidents per million vehicles entering.

D. Recommendations:

It is obvious from the accident diagrams that there is some difficulty in identifying this curved section of road. Due to the fact that these reverse curves are between two long tangent sections, drivers are apparently caught off-guard. Straightening these curves would be a long-term improvement. Several short-term improvements could improve the situation in the interim, and are listed as follows:

1. Remove the existing reverse curve warning signs (W1-4).
2. Install winding road warning signs (W1-5) and 35 mph advisory

speed plates (W13-1) on the north and south approaches 750 feet from the beginning of the curve section. Note that the signs should be mounted not less than five feet above the shoulder elevation.

3. Install a series of chevron signs (W1-8) along the reverse curves as shown in Figure 14B.

4. Install a series of reflectorized delineators on both approaches as shown on Figure 10.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
1	ea	Relocate Reverse Curve Warning Sign (W1-4) with Advisory Speed Plate (W13-1)	$60/ea	$ 60.00
16	ea	Install Reflectorized Delineator, 4" x 4", Design "F"	$15.50/ea	248.00
1	ea	Install Reverse Curve Sign with Advisory Speed Plate (W13-1)	$180/ea	180.00
26	ea	Install Chevron Sign (W1-8), 24" x 30"	$105/ea	2,730.00
TOTAL COST:				$3,218.00

BENEFIT/COST RATIO: 5.10

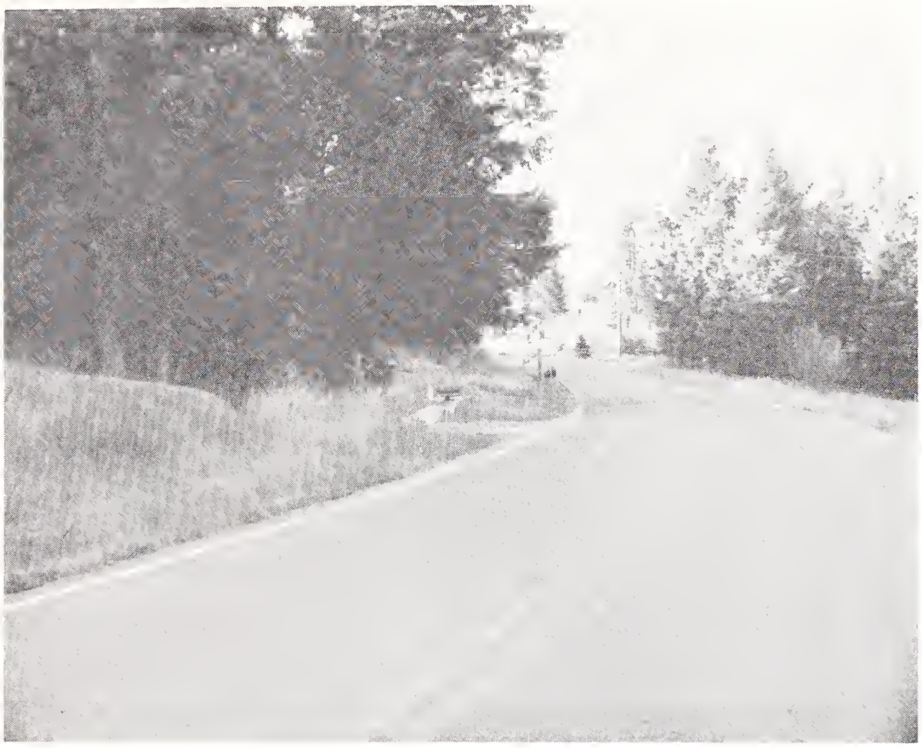
Long Term Improvements:

The degree of curvature of the reverse curves could be flattened by the acquisition of right-of-way on the east side of the road. Two one-half acre tracts of private land would be required, as shown on Figure 14B. The alignment could then be adjusted to provide better sight distance and therefore a safer facility.

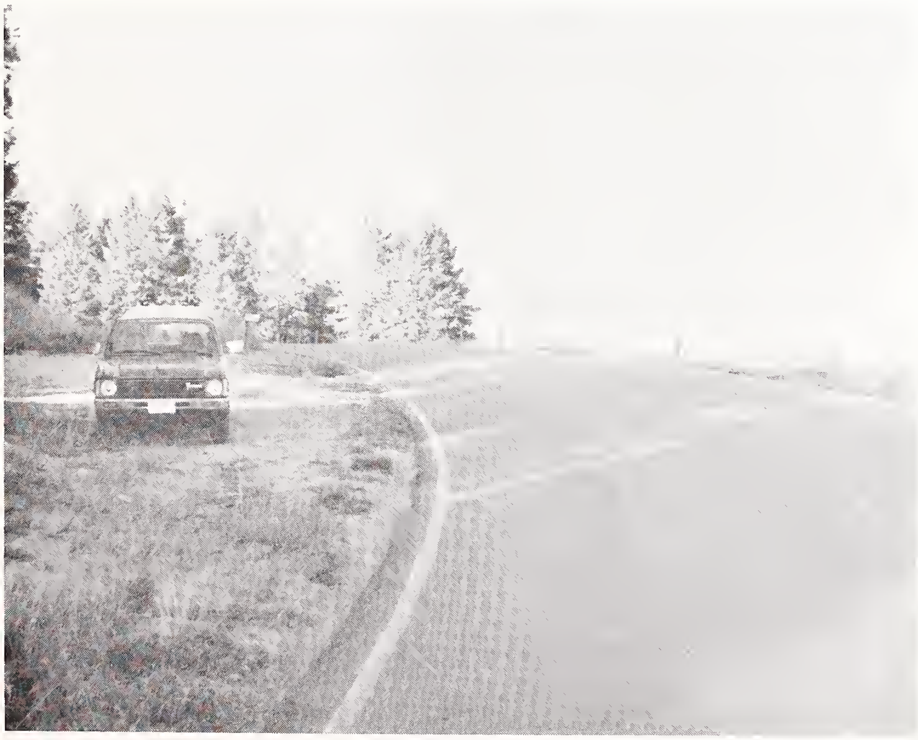
Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
1	ea	Relocate Signs and Restripe	Lump Sum	3,000.00
4000	sy	Remove and Relocate 24' Wide, 3" Full-Depth Asphalt	$12/sy	48,000.00
TOTAL LONG-TERM IMPROVEMENT COST:				* $51,000.00

* Estimate does not include right-of-way acquisition costs.



View of the reverse curve on the North Whitefish Stage Road. Note the driveways on left.



View of the south portion of the curve. Note limited sight distance.

ACCIDENT DATA

NORTH WHITEFISH STAGE ROAD

SITE NUMBER 14

ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
1	8	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
2		1	1	2	3	1

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
2			1	1		1	1	3			1

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
2	2								1		1	1	1							1			1

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	*Dark*	*Dawn*	*Dusk*
5	5		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
8		1	1	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
9		1	

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Side-swipe*	*Non-Col*	*Head-on*	*Backing*
			4				6		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
1	1		3					5

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	0	2	0
Fatality	0	1	0
Property Dam. Only	1	5	1

DETERMINATION OF HAZARD INDEX

Site Number 14 Date November, 1981

Site Description North Whitefish Stage Road

Indicator	Data Value		Indicator Value	Weight		Partial H.I.'s
Number of Accidents	3.3	acc/yr	48	x 0.164	=	7.87
Accident Rate	19.1	acc/MVE	100	x 0.225	=	22.50
Accident Severity	12,400	dollars	68	x 0.191	=	12.99
Volume/Capacity Ratio	0.06		20	x 0.082	=	1.64
Sight Distance Ratio	0.28	(wt. avg.)	100	x 0.074	=	7.40
Driver Expectancy	4.7	(wt. avg.)	7.8	x 0.149	=	11.62
Information System Deficiencies	3.5	(wt. avg.)	58	x 0.115	=	6.67

Hazard Index: 70.69

Cost of Recommended Improvements: $3,218.00

Cost Factor: 94

Priority Index = Hazard Index x .75 + Cost Factor x .25

70.69 x .75 + 94 x .25 = 76.52

EXISTING CONDITIONS & COLLISION DIAGRAM

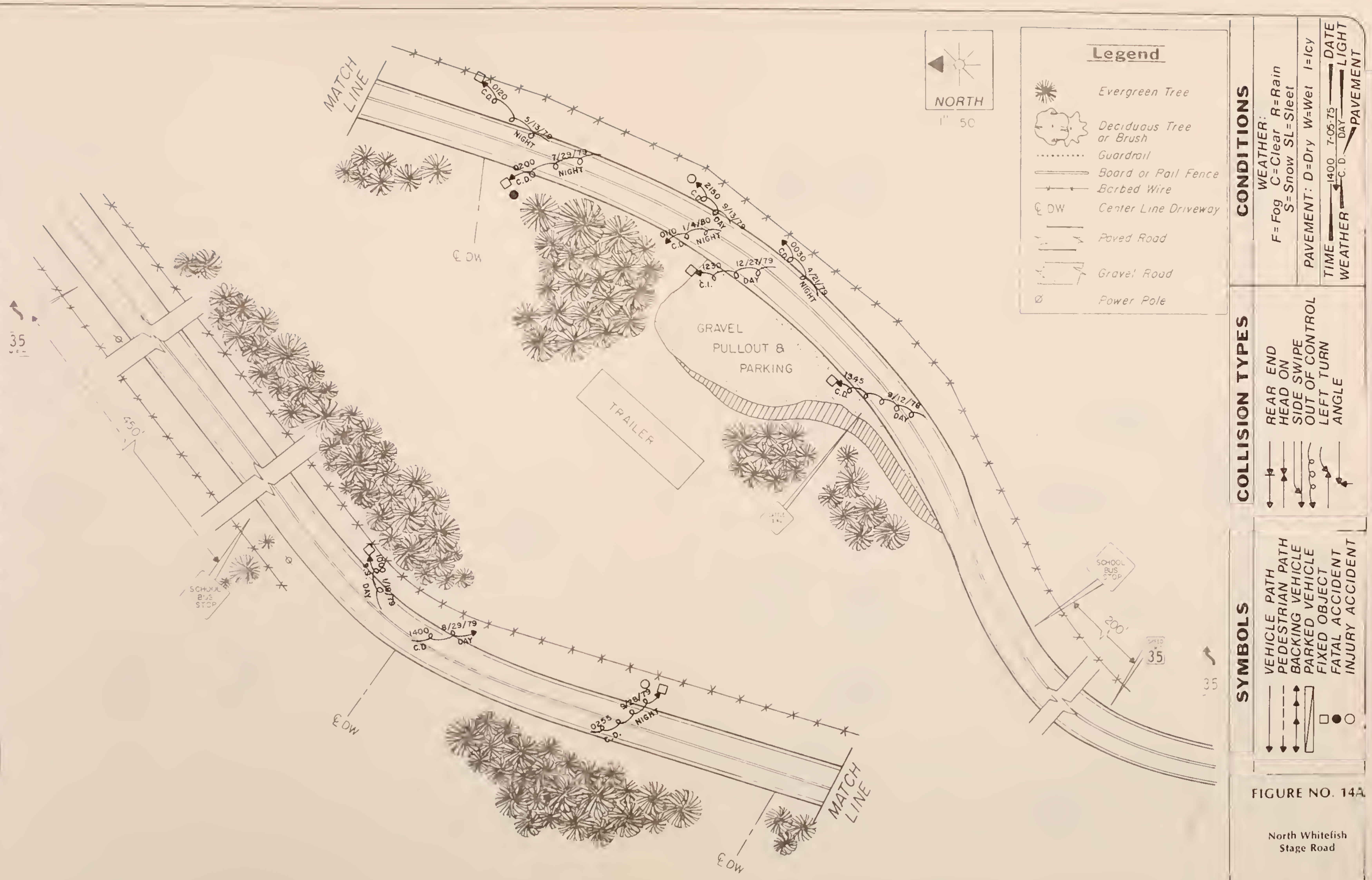


FIGURE NO. 14A

North Whitefish Stage Road

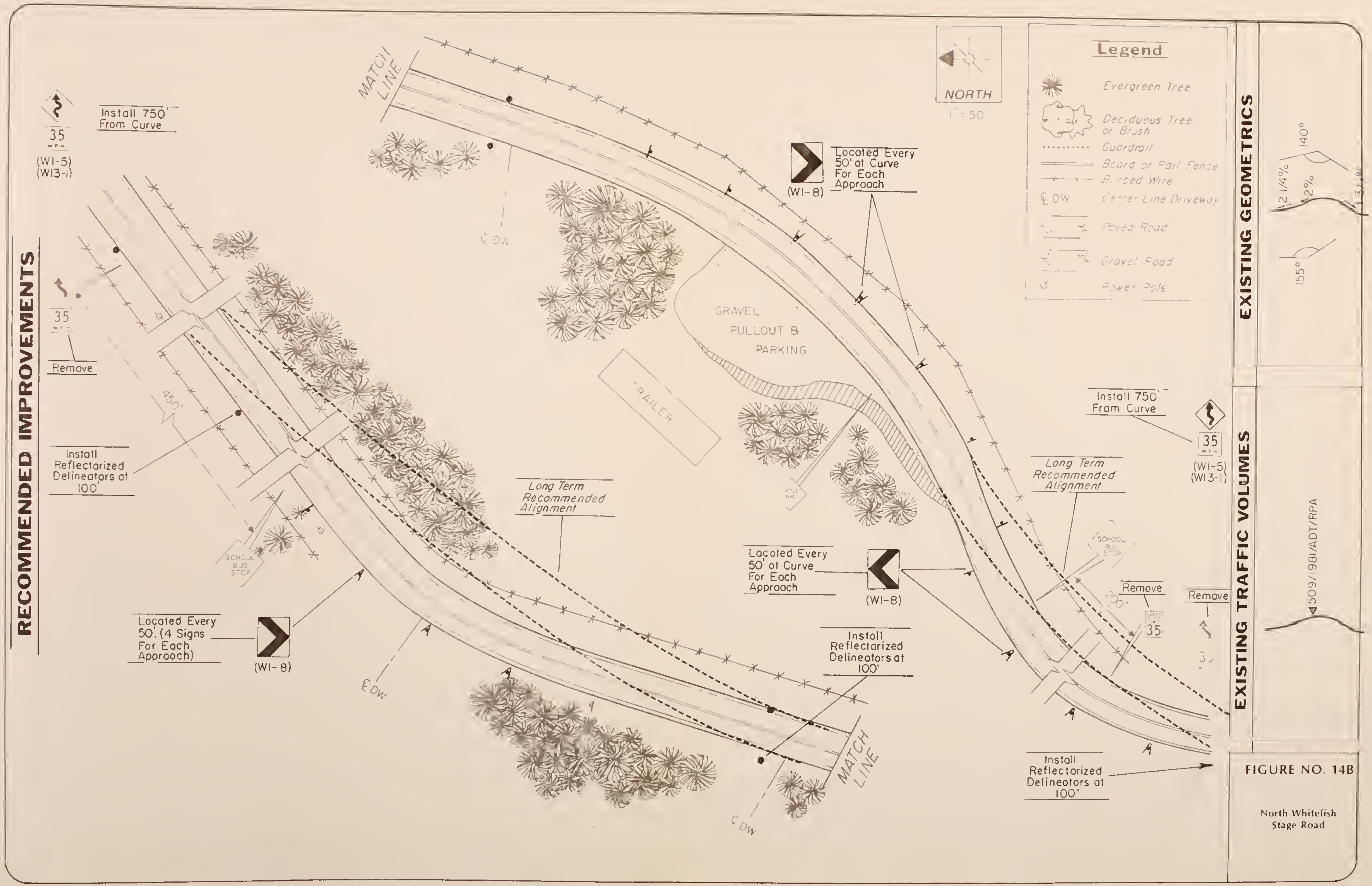


FIGURE NO. 14B

North Whitefish
Stage Road

S
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15

SITE NUMBER 15

COLUMBIA FALLS STAGE AT RED BRIDGE

A. Location:

Site 15 is located approximately three miles southeast of Columbia Falls and includes the curve and south approach to the single-lane Flathead River Bridge. The roadway is located in a densely developed rural residential area and serves primarily local traffic.

B. Existing Conditions:

The asphalt pavement surface of Columbia Falls Stage Road is typically 22 feet wide through the section. Grades in the section fall from three percent on the bridge approach to .5 percent in the curve that follows. There is no pavement striping through the site, probably due to the recently completed chip and seal resurfacing. The posted speed limit for the site is 35 mph. The only warning sign within the section is a "Slippery When Wet" sign; regulatory signing includes a "Load Limit - 5 tons" sign and a "No Parking on Pavement" sign. Guard rail sections on the bridge approach are wood or metal. Object marker panels are located at the beginning of guard rail sections on both sides of the bridge approach. The single lane bridge requires that traffic stop on either side of the bridge until traffic on the bridge clears. Sight distance is limited on the approach to the bridge by the grade and the length of the bridge. Numerous vehicles were observed backing off the bridge because traffic from the north side of the bridge was hidden from view. The roadway is heavily used as a route to and from school by area children; approximately 30 school-age pedestrians were observed walking along the roadway between 8:00 and 8:30 a.m. and 3:30 and 4:00 p.m. There are no facilities on the bridge or the roadway to segregate pedestrians and vehicle traffic. Existing conditions are depicted in Figure 15A and Plate 15.

Twenty-four hour machine counts of traffic volumes were conducted by Robert Peccia and Associates during November, 1981. Based on this data, the 1981 ADT was determined to be 1,596 vehicles per day. Because of the weight restrictions placed on the bridge, heavy vehicles (school buses, delivery trucks, etc) are forced to use alternate routes. Traffic on the roadway generally consists of local residents commuting to and from Columbia Falls.

C. Accident History:

There were seven reported accidents at this location during the three-year study period. In five cases, poor road conditions were a factor. A wide variety of accident types occurred, with sideswipes being most prominent. Four accidents resulted in injuries, but none of the accidents involved pedestrians. The largest cluster of accidents occurred on the south

approach to the Red Bridge. This is partially due to the poor sight distance and the narrow one-lane condition on the bridge. The accident rate at this location is 4.3 accidents per million vehicles entering.

D. Recommendations:

The accident records indicate that the bridge approach is not adequately identified. The curves could also be better delineated. The pedestrians on the bridge are of particular concern. For the present, it is strongly recommended that law enforcement efforts to insure the safety of the school children crossing the bridge be increased. The periodic presence of a patrol car near the site during the morning and evening crossing hours could have a substantial effect. The average vehicle appears to approach the bridge too fast and the limited sight distance on the actual bridge approach adds to the problem.

The following short-term improvements are recommended:

1. Install reflectors on the east side of the south bridge approach back through the curve and for 500 feet south of the curve (see Figure 15B). The reflectors should be 4" x 4" Design "C" type.
2. Install a double solid centerline stripe and shoulder striping from 500 feet south of the curve to a point on the bridge approach adjacent to the end of the guard rail on the east side of the road.
3. Install a one-lane bridge sign (W5-3) 500 feet from the end of the bridge on the south approach. A 10 mph advisory speed plate (W13-1) should accompany this warning sign.
4. Install a curve warning sign (W1-2) 750 feet from the beginning of the curve on the south approach. Install a similar sign 100 feet from the end of the bridge for the southbound traffic.
5. Widen the shoulder on the west side of the road to a minimum of six feet to provide for the pedestrian traffic.
6. Install directional arrows (W6-1) on the curve so they can be clearly seen for 500 feet in both directions.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
13	ea	Install Reflectorized Delineator, 4" x 4", Design "C"	$18/ea	$ 234.00
3600	lf	Paint Striping 4" Wide Solid	$0.04/lf	144.00
1	ea	Install One Lane Bridge Warning Sign (W5-3)	$130/ea	130.00

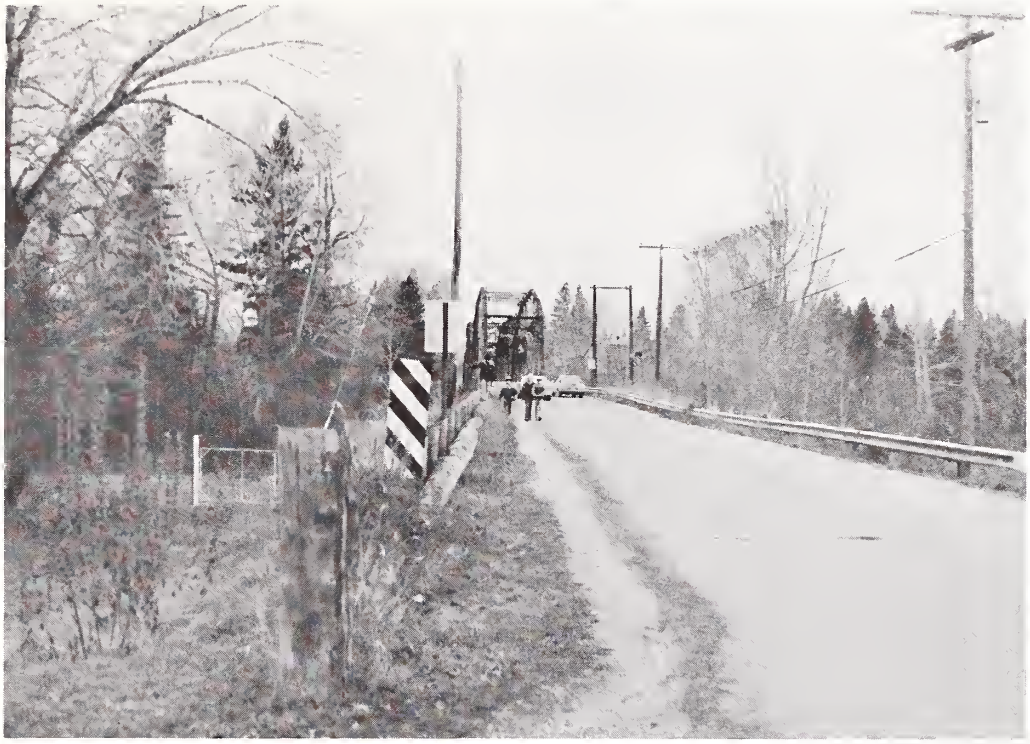
Improvement Cost Estimate
(cont.)

Quantity	Unit	Item Description	Unit Price	Total Price
2	ea	Install Curve Warning Sign (W1-2)	$130/ea	260.00
1	ea	Install Advisory Speed Plate (W13-1)	$50/ea	50.00
200	cy	Fill Material	$3/cy	600.00
50	cy	Gravel	$8/cy	400.00
2	ea	Install Directional Arrow (W6-1), 48" x 24"	$163/ea	326.00
TOTAL COST:				$2,144.00

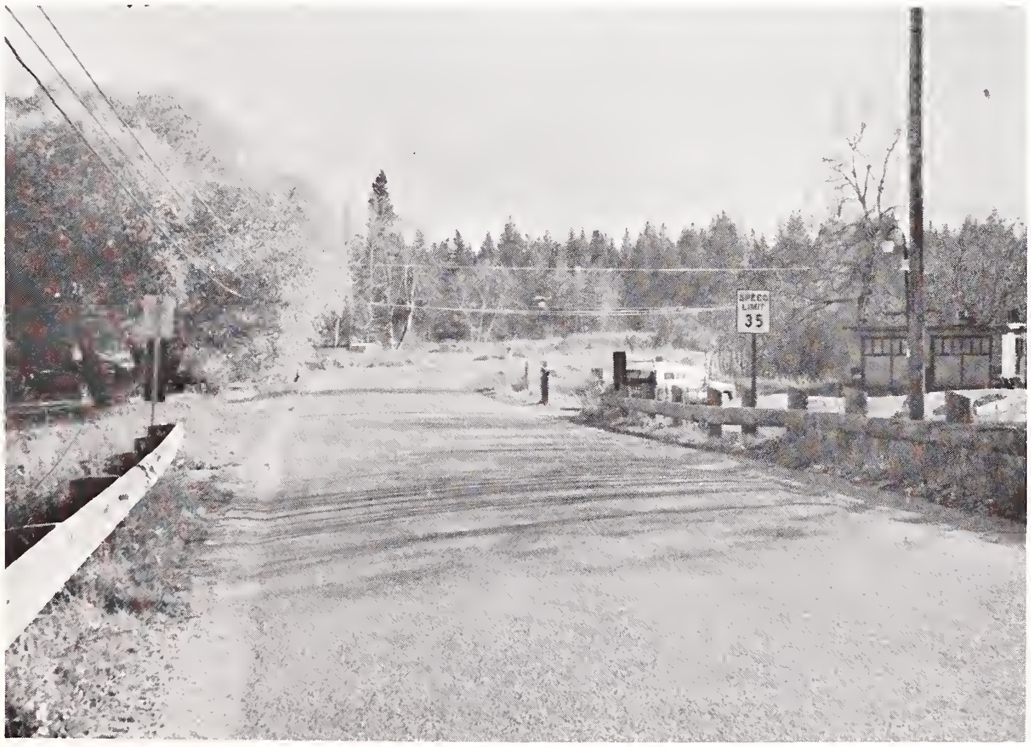
BENEFIT/COST RATIO: 3.69

Long-Term Improvement:

A significant safety improvement could be made for those school children who must cross this long, narrow, single-lane bridge by picking them up on the south side of the river and busing them to school. The bus presently travels within one block of the south approach to the bridge, but due to school district busing policy these children are not allowed to use the bus. The nature of this location endangers the lives of the children who travel to school along the roadway and bridge. Due to the severity of the situation, it is recommended that an exception to the school bus policy be made and bus service be provided. Due to the nature of this long-term improvement, no cost has been included.



View of the south approach to the Red Bridge. Note pedestrians on bridge approach.



View of the curve at the south end of the bridge as seen from the north.

ACCIDENT DATA

COLUMBIA FALLS STAGE AT RED BRIDGE

SITE NUMBER 15

ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
5	2	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1	1	1		1	1	2

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	1			1		1	1			1	1

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	1						1			1	1				1				1		1		

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Daylight	Dark	Dawn	Dusk
5	2		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
2	2	2	1	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
4	1	2	

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Sideswipe	Non-Col	Head-on	Backing
		1	1			3	1	1	

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
2		1	3					1

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	2	2	0
Fatality	0	0	0
Property Dam. Only	3	0	0

Robert Peccia & Associates

DETERMINATION OF HAZARD INDEX

Site Number 15 Date November, 1981

Site Description Columbia Falls Stage at Red Bridge

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	2.3 acc/yr	37	x 0.164 =	6.07
Accident Rate	4.3 acc/MVE	62	x 0.225 =	13.95
Accident Severity	15,171 dollars	76	x 0.191 =	14.52
Volume/Capacity Ratio	0.26	42	x 0.082 =	3.44
Sight Distance Ratio	0.89 (wt. avg.)	42	x 0.074 =	3.11
Driver Expectancy	5.3 (wt. avg.)	89	x 0.149 =	13.26
Information System Deficiencies	4.0 (wt. avg.)	67	x 0.115 =	7.71

Hazard Index: 62.06

Cost of Recommended Improvements: $2,144.00

Cost Factor: 98

Priority Index = Hazard Index x .75 + Cost Factor x .25

62.06 x .75 + 98 x .25 = 71.05

EXISTING CONDITIONS & COLLISION DIAGRAM

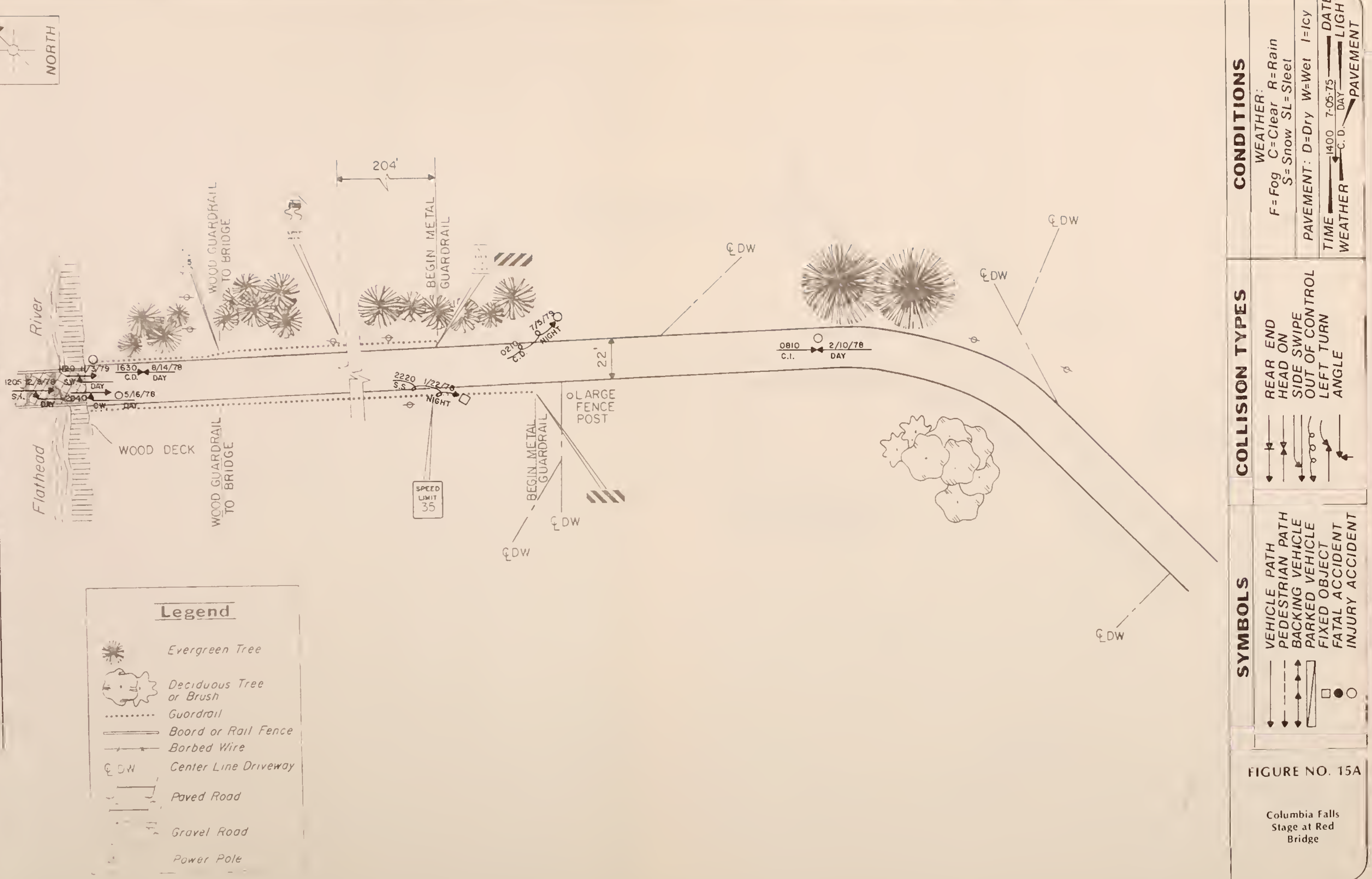
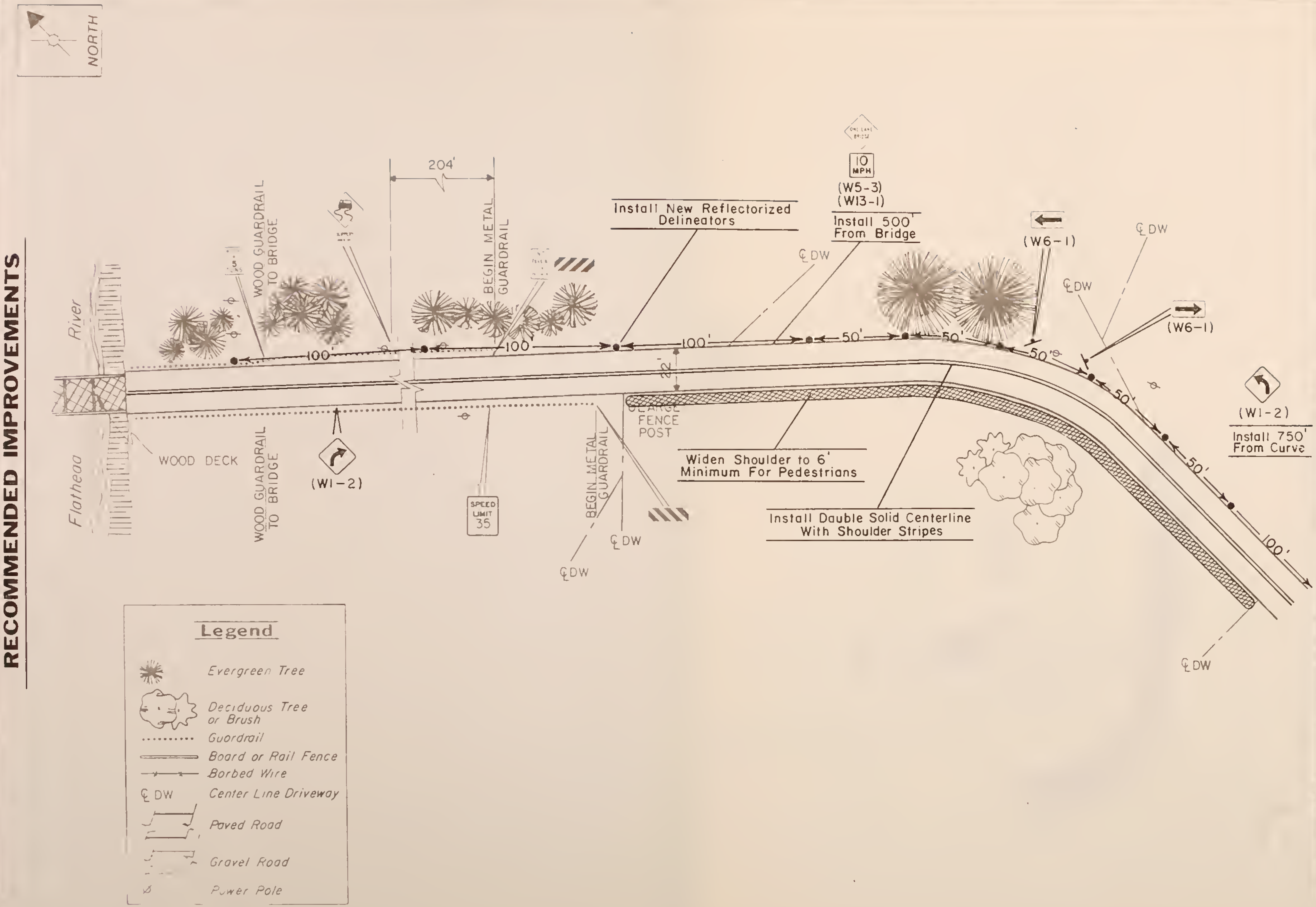


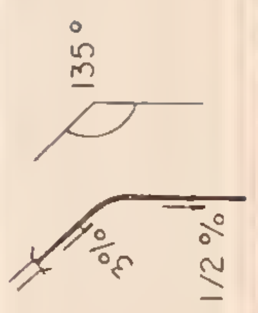
FIGURE NO. 15A

Columbia Falls Stage at Red Bridge

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

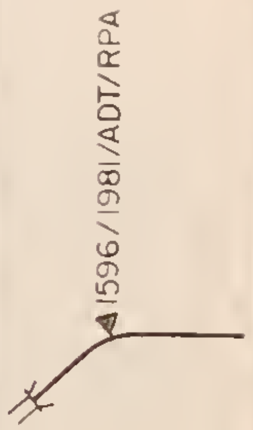


FIGURE NO. 15B

Columbia Falls
Stage at Red
Bridge

S
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T
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16

SITE NUMBER 16

TAMARACK LANE, COLUMBIA FALLS

A. Location:

Site 16 consists of a 90-degree corner on Tamarack Lane located approximately one mile northwest of Columbia Falls. The site is located in rural countryside and is characterized by small areas of residential development.

B. Existing Conditions:

Tamarack Lane is a 24-foot-wide asphalt surfaced roadway with uniform and flat grades. There is no pavement striping, due to a recently completed chip and seal resurfacing project. Curve warning signs with advisory speed plates of 20 mph are located on both approaches to the site as shown in Figure 16A. Sight distance around the corner is limited by several large evergreen trees growing within ten feet of the edge of the roadway, by a residence with several outbuildings. The trees and a power pole on the inside of the bend constitute roadway obstructions. Plate 16 depicts the existing site conditions from both approaches to the corner.

Machine counts of 24-hour traffic volumes were collected for the site by Robert Peccia and Associates in November, 1981. Based on this data, the 1981 ADT was determined to be 304 vehicles per day.

C. Accident History:

Three accidents were reported in the three-year period; a head-on, a sideswipe, and a single vehicle accident. All three occurred in the 90-degree bend on Tamarack Lane, and two of the accidents involved injuries. The head-on and sideswipe accidents were caused in part by the limited sight distance. The accident rate at this location is 9.6 accidents per million vehicles entering.

D. Recommendations:

The 90-degree bend in Tamarack Lane is complicated by a narrowing of the pavement width in the curve and very limited sight distance. This extreme change in road alignment occurs at the end of two long tangent approaches which requires the motorist to be alert and respond quickly. Several short-term improvements, including pavement striping and delineators, could correct some of the deficiencies at this site. The alignment problem cannot be resolved with short-term improvements. The long-term solution will require the acquisition of land and major road construction.

The short-term improvements are as follows:

1. Widen the pavement width in the curve from 18 feet to 22 feet, which is the width of both approaches.

2. Install a solid double centerline stripe and shoulder stripes on Tamarack Lane beginning at least 500 feet back on the approaches and extending through the curve.

3. Remove the curve warning signs (W1-1) on both approaches and relocate them 750 feet from the curve. The accompanying 20 mph speed plate should be replaced with a 10 mph advisory speed plate (W13-1). According to the AASHO Geometric Highway Design Manual, the design speed for this curve is 10 mph, based on an existing radius of 30 feet and a superelevation of 0.6 ft/ft. A vehicle equipped with a ball bank indicator was also used to determine the safe traveling speed for this curve. The results indicated that 10 mph is appropriate.

4. Install a series of reflectorized delineators extending back on both approaches 500 feet. The reflectors should be placed in a fashion that will guide the motorist around this corner, as shown in Figure 16B.

5. Install directional arrows (W1-6) on the curve and place them so they can be clearly seen from 500 feet back on both approaches.

6. It is strongly recommended that the county continue their efforts to have the privately owned trees on the inside of the curve pruned or removed. These trees, which drastically limit sight distance, are partially responsible for two accidents in the last three years, one of which involved an injury.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
4800	lf	Paint Striping 4" Wide Solid	$0.04/lf	$192.00
2	ea	Relocate Curve Warning Sign (W1-1) and Advisory Speed Plate (W13-1)	$60/ea	120.00
16	ea	Install Reflectorized Delineator, 4" x 4", Design "F"	$15.50/ea	248.00
12	ea	Install Reflectorized Delineator, 4" x 4", Design "C"	$18/ea	216.00
2	ea	Install Directional Arrow (W1-6), 48" x 24"	$163/ea	326.00
100	cy	Gravel Fill	$8/cy	800.00
75	sy	Asphalt Pavement, 3" Full Depth	$6/sy	450.00
TOTAL COST:				$2,352.00

BENEFIT/COST RATIO: 4.71

Long Term Improvements:

The road should be realigned to pass on the northeast side of the existing houses on the corner. A much more gentle curve alignment should be used so proper sight distance can be maintained. This entire improvement would consist of abandoning the east approach and utilizing the north approach as an access road to the private property near the bend. Acquisition of approximately 1.4 acres for the necessary right-of-way would be required.

Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
1000	sy	Scarify Road Surface	$2/sy	2,000.00
2400	cy	Excavation	$6/cy	14,400.00
3000	sy	Asphalt Pavement, 24' Wide 3" Full-Depth Asphalt	$6/cy	18,000.00
TOTAL LONG-TERM IMPROVEMENT COST:				* $36,400.00

* Estimate does not include right-of-way acquisition costs.

View of the 90-degree bend in Tamarack Lane from the east approach.

View of the same curve from the north approach.

ACCIDENT DATA

TAMARACK LANE

SITE NUMBER 16 *ACCIDENT PERIOD* 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
2	1	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
	1			1		1

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
	1								1	1	

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
													1	1				1					

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	*Dark*	*Dawn*	*Dusk*
2	1		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
1			2	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
3			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Side-swipe*	*Non-Col*	*Head-on*	*Backing*
						1	1	1	

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
			1				1	1

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	1	0	0
Fatality	0	0	0
Property Dam. Only	1	1	0

Robert Peccia & Associates

DETERMINATION OF HAZARD INDEX

Site Number 16 Date November, 1981

Site Description Tamarack Lane

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	1.0 acc/yr	27	x 0.164 =	4.43
Accident Rate	9.6 acc/MVE	97	x 0.225 =	21.83
Accident Severity	17,200 dollars	79	x 0.191 =	15.09
Volume/Capacity Ratio	0.06	20	x 0.082 =	1.64
Sight Distance Ratio	0.42 (wt. avg.)	100	x 0.074 =	7.40
Driver Expectancy	4.0 (wt. avg.)	67	x 0.149 =	9.98
Information System Deficiencies	3.5 (wt. avg.)	58	x 0.115 =	6.67

Hazard Index: 67.04

Cost of Recommended Improvements: $2,352.00

Cost Factor: 92

Priority Index = Hazard Index x .75 + Cost Factor x .25

67.04 x .75 + 92 x .25 = 73.28

EXISTING CONDITIONS & COLLISION DIAGRAM

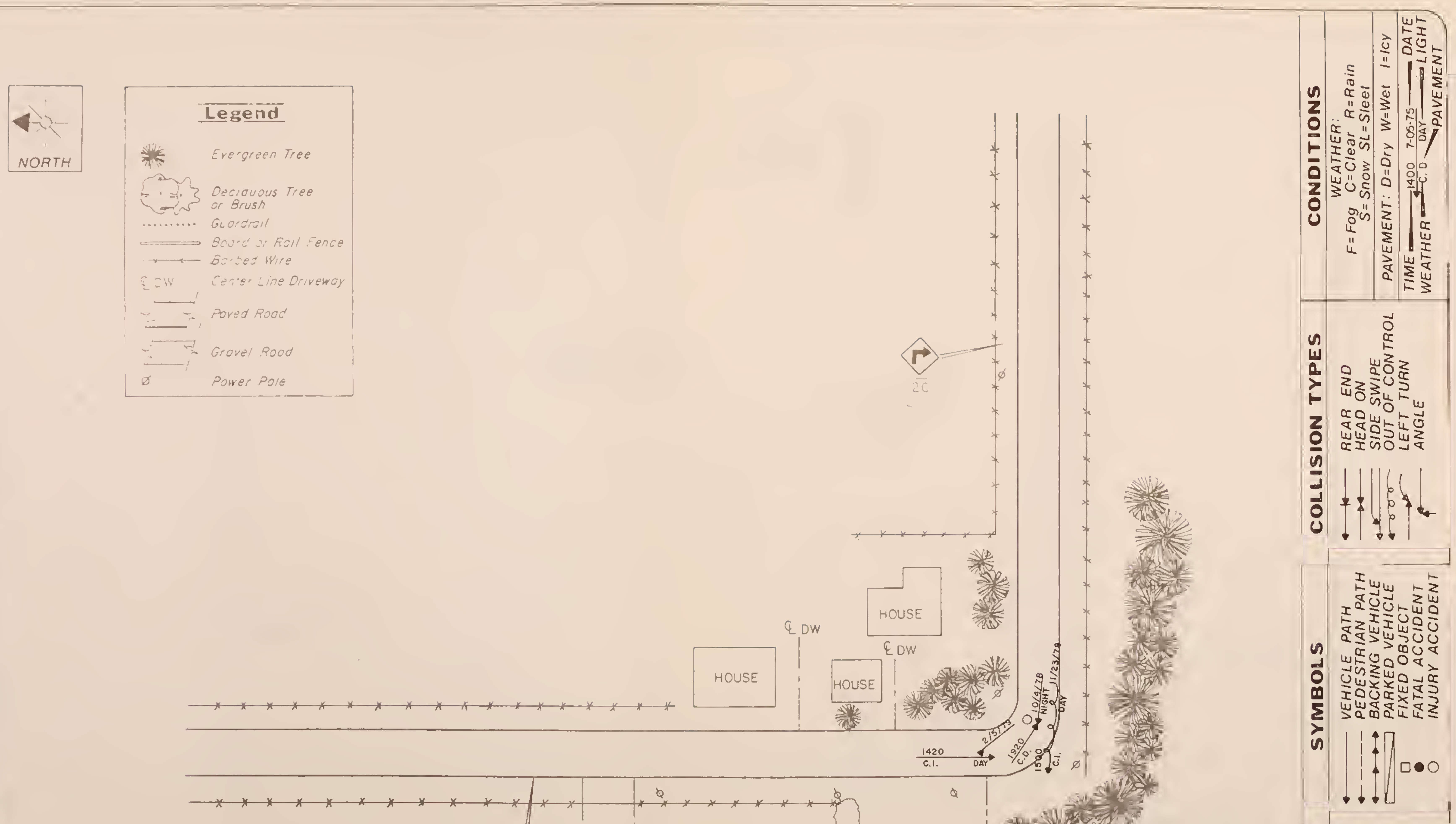
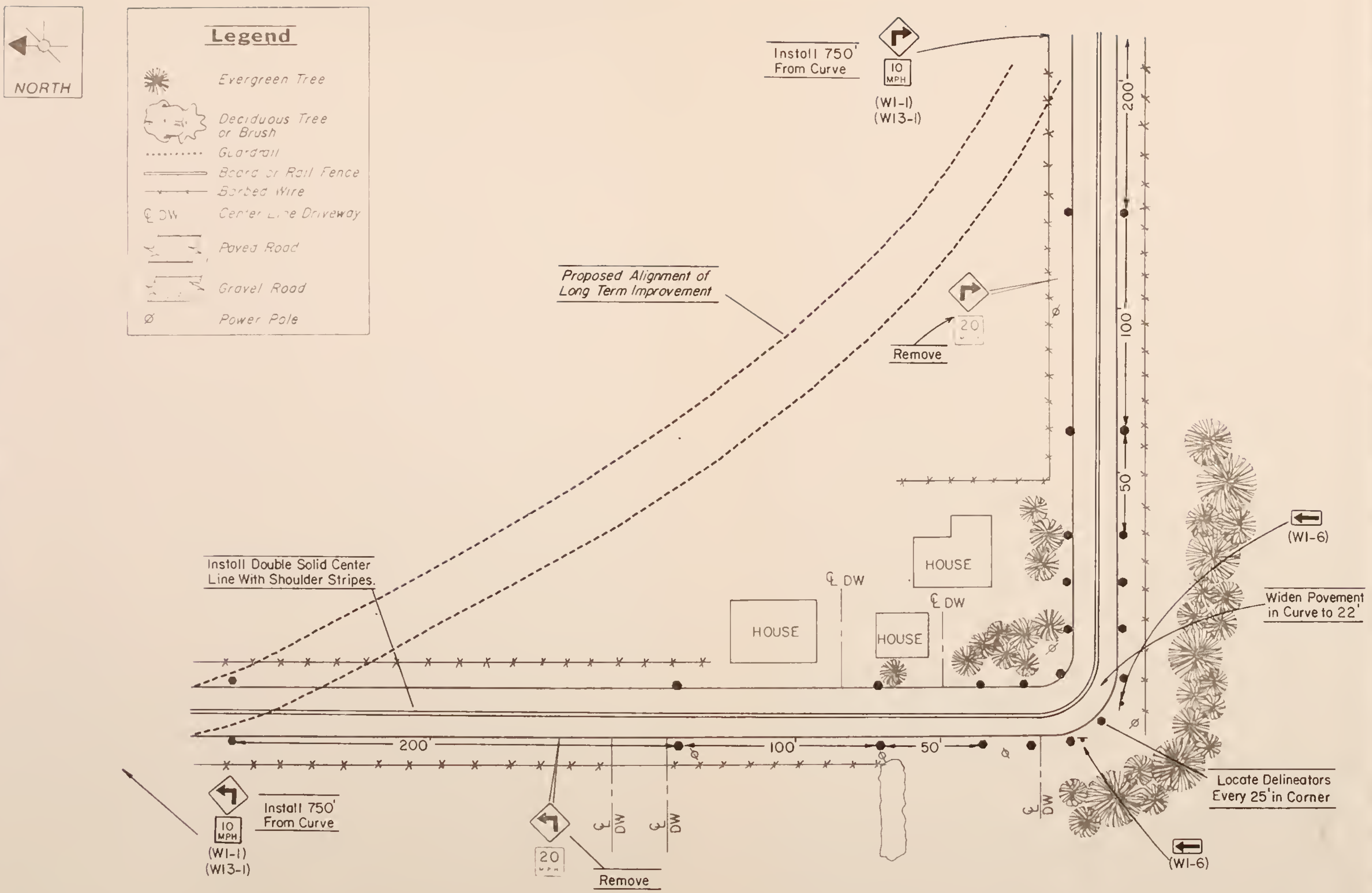


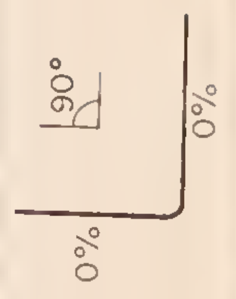
FIGURE NO. 16A

Tamarack Lane

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

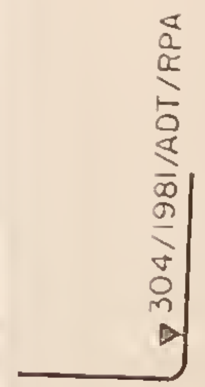


FIGURE NO. 16B

Tamarack Lane

S
I
T
E
17

SITE NUMBER 17

ARMORY ROAD, WHITEFISH

A. Location:

Site 17 includes a 100-degree corner on Armory Road approximately .4 miles east of the City of Whitefish. The road is situated in a heavily developed rural residential area and primarily serves residents of several subdivisions in the area.

B. Existing Conditions:

Armory Road has an asphalt pavement surface which varies from 18 to 20 feet in width. There are no pavement markings through the section. Grades at the site range from 2.5 percent on the north approach to five percent on the east approach. Curve warning signs with 15 mph speed advisory plates are located along each approach to the corner, and a directional arrow is located west of the intersection and is visible from the east approach. A gravel driveway intersects Armory Road at the corner and serves one residence. Sight distance is somewhat limited on the east approach due to the grade, but other obstructions are generally greater than six feet from the roadway. Due to the sharpness of the corner and the low traffic volumes, drivers approaching from the north often tend to use the inside lane of the curve. Existing site conditions are depicted in Figure 17A and Plate 17.

Based on machine counts of 24-hour traffic volumes conducted by Robert Peccia and Associates, the 1981 ADT was determined to be 201 vehicles per day.

C. Accident History:

Seven accidents were reported at this site during the three-year study period, but only one accident involved an injury. All of the accidents occurred as a result of the 90-degree bend at this location when the motorists apparently swerved into the oncoming traffic or off the road at this location. The accident rate of this site is 33.8 accidents per million vehicles entering.

D. Recommendations:

The motorist must be made more aware of the situation that exists at this location. Through proper delineation and signing, this corner can be properly identified.

The following improvements are recommended:

1. Widen the pavement in the curve to 20 feet. The existing usable roadway width presently narrows to 16 feet in the curve.
2. Install a double solid centerline stripe and shoulder stripes on Armory Road beginning at the intersection of Second Street and extending

south through the curve and for a minimum of 750 feet to the east.

3. Install a directional arrow (W1-6) on the west side of the curve adjacent to the driveway so it will be visible from at least 500 feet back on the north approach.

4. Relocate the curve warning signs (W1-1) to 750 feet from the curve on the north approach and 500 feet from the curve on the east approach. According to a ball bank indicator test performed at this location, the existing 15 mph speed is appropriate.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
75	sy	Asphalt Pavement, 3" Full Depth	$6/sy	$450.00
6000	lf	Paint Striping 4" Wide Solid	$0.04/lf	240.00
1	ea	Install Directional Arrow (W1-6), 48" x 24"	$163/ea	163.00
2	ea	Relocate Curve Warning Sign (W1-1) and Advisory Speed Plate (W13-1)	$60/ea	120.00

TOTAL COST: $973.00

BENEFIT/COST RATIO: 7.48

Long-Term Improvement

The shoulder of the road on the west side of the curve should be filled to an optimum shape of 6:1. This will require approximately 2,500 cubic yards of fill material. This fill will exceed the right-of-way limits by 10 to 20 feet. The replacement of the owner's fence is included in the cost of this improvement.

Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
2500	cy	Fill Material	$3/cy	$7,500.00
200	lf	Install 4-Strand Barbed Wire Fence	$2/lf	400.00
TOTAL LONG-TERM IMPROVEMENT COST:				* $7,900.00

* Estimate does not include easement costs.

View of the 90-degree bend and the north approach.

View of the 90-degree bend from the east approach.

ACCIDENT DATA

ARMORY ROAD, WHITEFISH

SITE NUMBER 17 *ACCIDENT PERIOD* 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
4	0	3

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
2	1		1	1		2

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
2	1						1		1		2

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
		1										1		1	1								3

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	*Dark*	*Dawn*	*Dusk*
3	4		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
1	1	1	4	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
5		2	

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Side-swipe*	*Non-Col*	*Head-on*	*Backing*
1			2			1	2	1	

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
3	1		2					1

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	1	0	1
Fatality	0	0	0
Property Dam. Only	3	0	2

DETERMINATION OF HAZARD INDEX

Site Number 17 Date November, 1981

Site Description Armory Road, Whitefish

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	2.3 acc/yr	40	x 0.164 =	6.56
Accident Rate	33.8 acc/MVE	100	x 0.225 =	22.50
Accident Severity	13,771 dollars	72	x 0.191 =	13.75
Volume/Capacity Ratio	0.06	20	x 0.082 =	1.64
Sight Distance Ratio	0.80 (wt. avg.)	53	x 0.074 =	3.92
Driver Expectancy	1.3 (wt. avg.)	22	x 0.149 =	3.28
Information System Deficiencies	2.0 (wt. avg.)	33	x 0.115 =	3.80

Hazard Index:	55.45
Cost of Recommended Improvements:	$973.00
Cost Factor:	94

Priority Index = Hazard Index x .75 + Cost Factor x .25

55.45 x .75 + 94 x .25 = 65.09

EXISTING CONDITIONS & COLLISION DIAGRAM

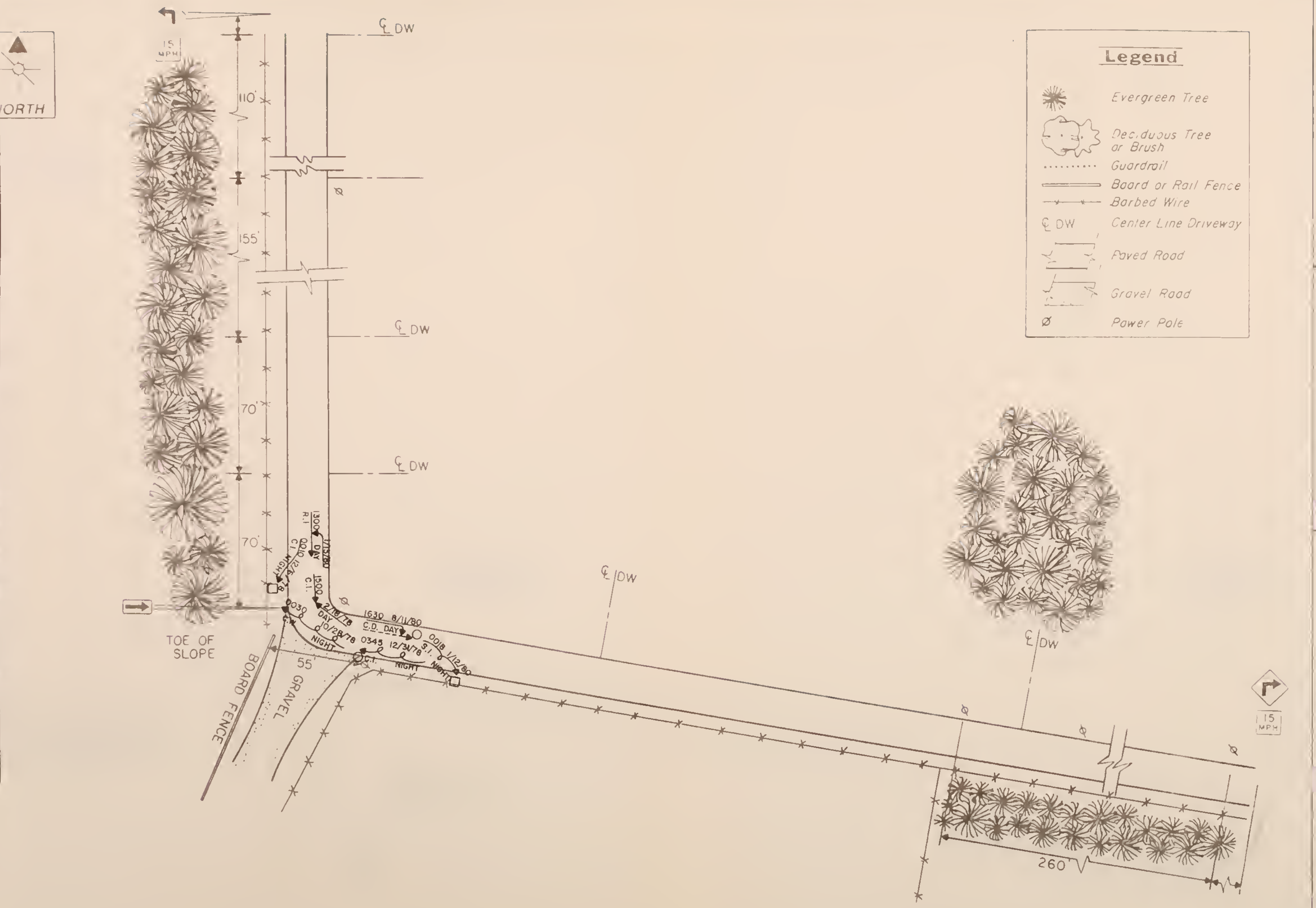
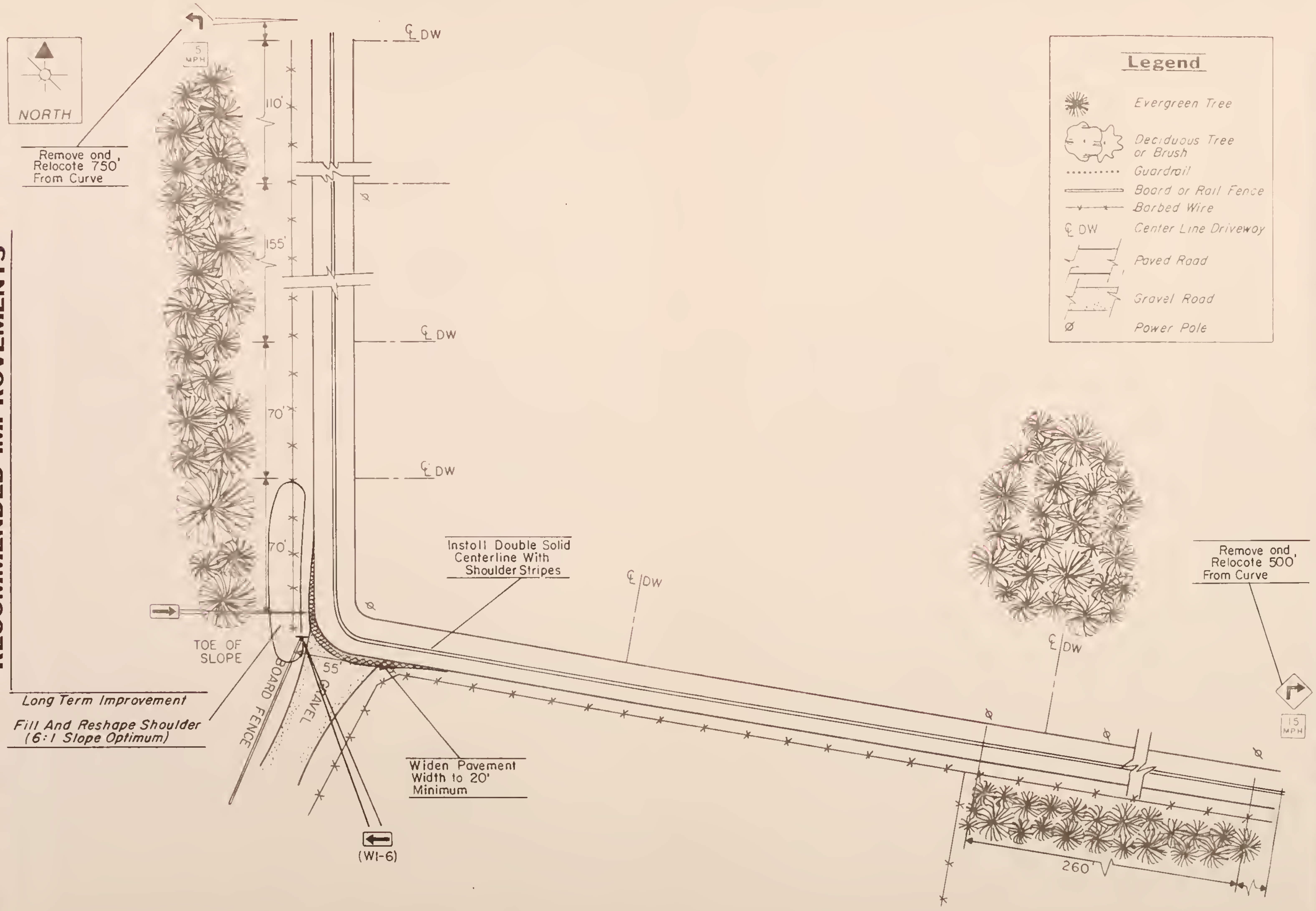


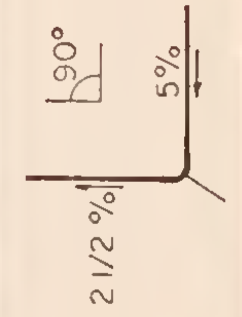
FIGURE NO. 17A

Armory Road,
Whitefish

RECOMMENDED IMPROVEMENTS


NORTH
5 MPH
Remove and Relocate 750' From Curve
℄ DW
110'
155'
70'
70'
55'
℄ DW
℄ DW
℄ DW
℄ DW
TOE OF SLOPE
BOARD FENCE
GRAVEL
Long Term Improvement
Fill And Reshape Shoulder (6:1 Slope Optimum)
Install Double Solid Centerline With Shoulder Stripes
Widen Pavement Width to 20' Minimum
(WI-6)
Remove and Relocate 500' From Curve
15 MPH
260'
Legend
Evergreen Tree
Deciduous Tree or Brush
Guardrail
Board or Rail Fence
Barbed Wire
℄ DW Center Line Driveway
Paved Road
Gravel Road
Power Pole

EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

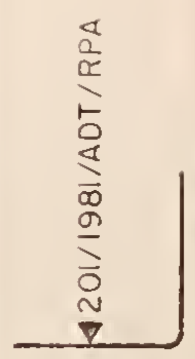


FIGURE NO. 17B

Armory Road, Whitefish

S
I
T
E
18

SITE NUMBER 18

INTERSECTION OF TWIN BRIDGES ROAD (FAS 424) AND K.M. RANCH ROAD

A. Location:

Site 18 is located in a rural area 4.5 miles southwest of Whitefish and includes the intersection of Twin Bridges Road and the K.M. Ranch Road. The site is located in rolling wooded terrain near the Stillwater River.

B. Existing Conditions:

Twin Bridges Road has an asphalt pavement surface which varies from 22 feet to 29 feet in width. K.M. Ranch Road is typically a 22-foot-wide gravel surfaced roadway; however, approximately 100 feet of roadway has been paved at the intersection. Grades vary between 3.5 and 4.5 percent on Twin Bridges Road. Grades on K.M. Ranch Road are 2.5 percent in the vicinity of the intersection. Twin Bridges Road is striped with a double solid centerline delineating the driving lanes. No warning signs are located within the site on Twin Bridges Road, but a stop sign is located on K.M. Ranch Road at the intersection. Due to the geometrics of the intersection, road grades and the thick roadside vegetation, sight distance is limited over much of the section. Drivers attempting to turn either direction off the K.M. Ranch Road must edge into the intersection to have adequate sight distance. Flathead County has recently improved the situation somewhat by removing or trimming some roadside vegetation that obscured sight distance. The wooden guard rail along the western approach is within six feet of the roadway and constitutes an obstruction. Existing site conditions are depicted in Figure 18A and Plate 18.

Traffic counts conducted by the Montana Department of Highways for Twin Bridges Road were used to determine 1981 ADT. The 1981 ADTs were determined to be 400 and 430 vehicles per day for the western and northern approaches, respectively. Traffic on the K.M. Ranch Road was estimated to be approximately 50 vehicles per day. Both roadways carry recreational traffic as well as local traffic.

C. Accident History:

There were no reported accidents at this location during the three-year period.

D. Recommendations:

There is no advance warning given to the motorist on the approach to this intersection. The long-term improvement recommends the reconstruction of the intersection to form a more standard "T" intersection alignment. Several short-term improvements can improve the sight distance and the advance warning signing.

The short-term improvements are as follows:

1. Install side road warning signs (W2-2) 750 feet from the intersection on both approaches on the Twin Bridges Road.
2. Install a stop ahead warning sign (W3-1) 500 feet south of the intersection on the Ranch Road. Due to the lower speeds on the gravel surface, the 500-foot setback was considered appropriate.
3. Cut the trees and shrubs on the southwest corner of the intersection that block the sight distance to the west (see Figure 18B).
4. Remove the trees and shrubs on the southeast corner and reshape the bank. This will provide the improved sight distance on the east approach.
5. Install a painted stop bar and centerline striping on the south approach adjacent to the existing stop sign.
6. Install reflectorized delineators along the north side of the Twin Bridges Road beginning 500 feet east of the intersection and continuing west around the curve and along the guard rail to the bridge (see Figure 18B.
7. Install amber reflectorized delineators (Design "D") on both sides of K.M. Ranch Road.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
2	ea	Install Side Road Warning Sign (W2-2)	$130/ea	$ 260.00
1	ea	Stop Ahead Warning Sign (W3-1)	$130/ea	130.00
½	ac	Clear and Grub	$2,000/ac	1,000.00
1	ea	Install Painted Stop Bar & Double Solid Centerline Striping	Lump Sum	30.00
15	ea	Install Reflectorized Delineator, 4" x 4", Design "C"	$18/ea	270.00
2	ea	Install Reflectorized Delineator, 4" x 8", Design "D"	$20/ea	40.00
TOTAL COST:				$1,730.00

BENEFIT/COST RATIO: 0.00*

* There were no accidents at this site; therefore, the Benefit/Cost Ratio is zero.

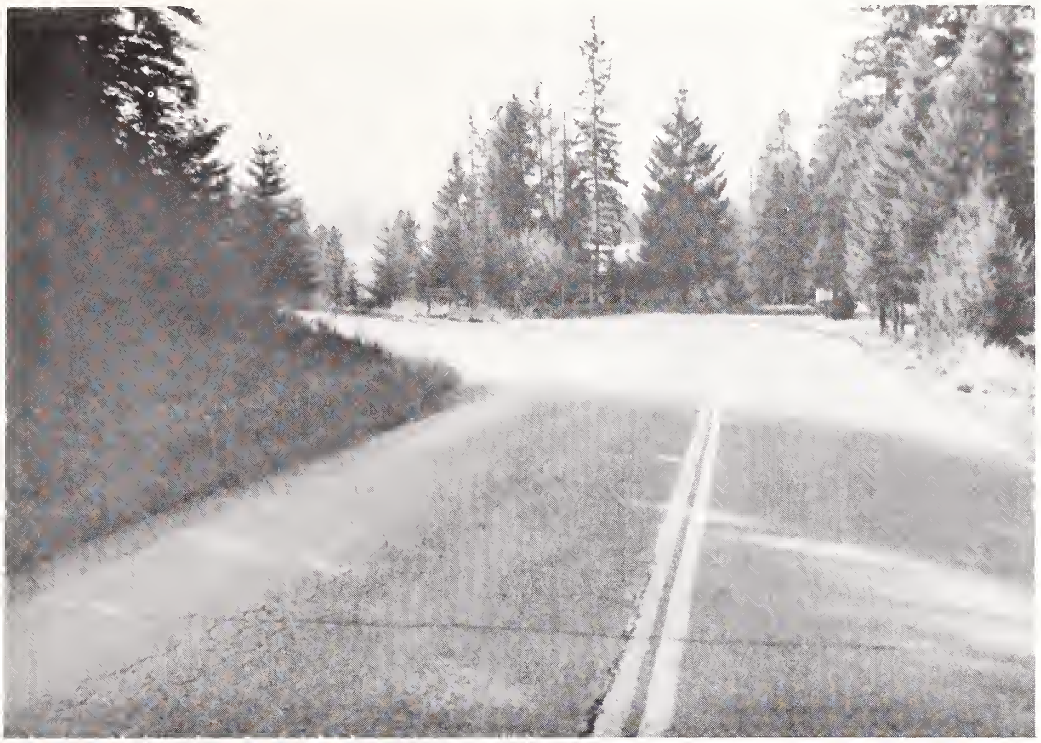
Long-Term Improvements:

The optimum solution to the sight distance problem at this location requires the reconstruction of the intersection. The recommended alignment is shown on Figure 18B. By shifting the point of access to the west, the sight distance would be improved on all approaches. The upsloping bank on the south side of the road should be pushed back to provide adequate site distance to the west approaches. This realignment would require the acquisition of approximately ¼ acre of right-of-way on the southwest corner of the intersection and the reconstruction of 400 feet of the K.M. Ranch Road.

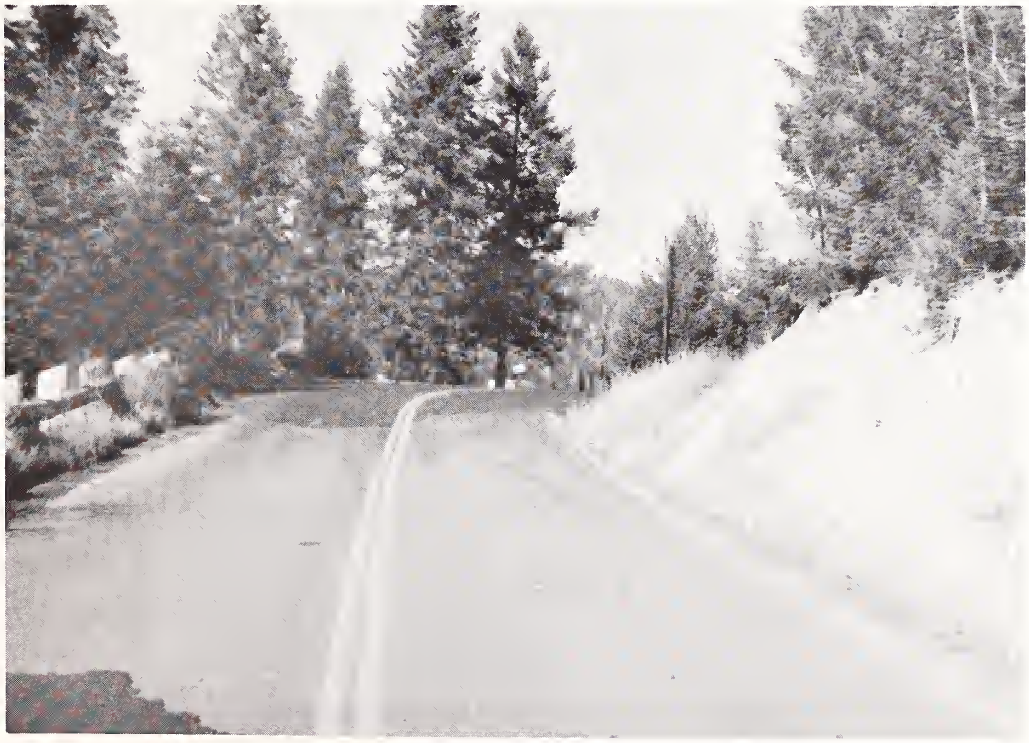
Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
1800	cy	Excavation	$6/cy	$10,800.00
150	cy	Crushed Gravel	$8/cy	1,200.00
250	sy	Asphalt Paving, 3" Full Depth	$6/sy	1,500.00
900	sy	Scarifying Old Road Bed	$2/sy	1,800.00
TOTAL LONG-TERM IMPROVEMENT COST:				* $15,300.00

* Estimate does not include right-of-way acquisition costs



View of the K.M. Ranch Road intersection from the east approach. Note trees and shrubs obstructing view of the south approach.



View of the same intersection from the west approach on Twin Bridges Road. Note bank on right blocking view of the intersection.

DETERMINATION OF HAZARD INDEX

Site Number 18 Date November, 1981

Site Description Intersection of Twin Bridges Road (FAS 424) and K.M. Ranch Road

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	0 acc/yr	0	x 0.164 =	0
Accident Rate	0 acc/MVE	0	x 0.225 =	0
Accident Severity	0 dollars	0	x 0.191 =	0
Volume/Capacity Ratio	0.01	6	x 0.082 =	.49
Sight Distance Ratio	0.56 (wt. avg.)	90	x 0.074 =	6.66
Driver Expectancy	4.7 (wt. avg.)	78	x 0.149 =	11.62
Information System Deficiencies	4.5 (wt. avg.)	75	x 0.115 =	8.63

Hazard Index: 27.40

Cost of Recommended Improvements: $1,730.00

Cost Factor: 96

Priority Index = Hazard Index x .75 + Cost Factor x .25

27.40 x .75 + 96 x .25 = 44.55

EXISTING CONDITIONS & COLLISION DIAGRAM

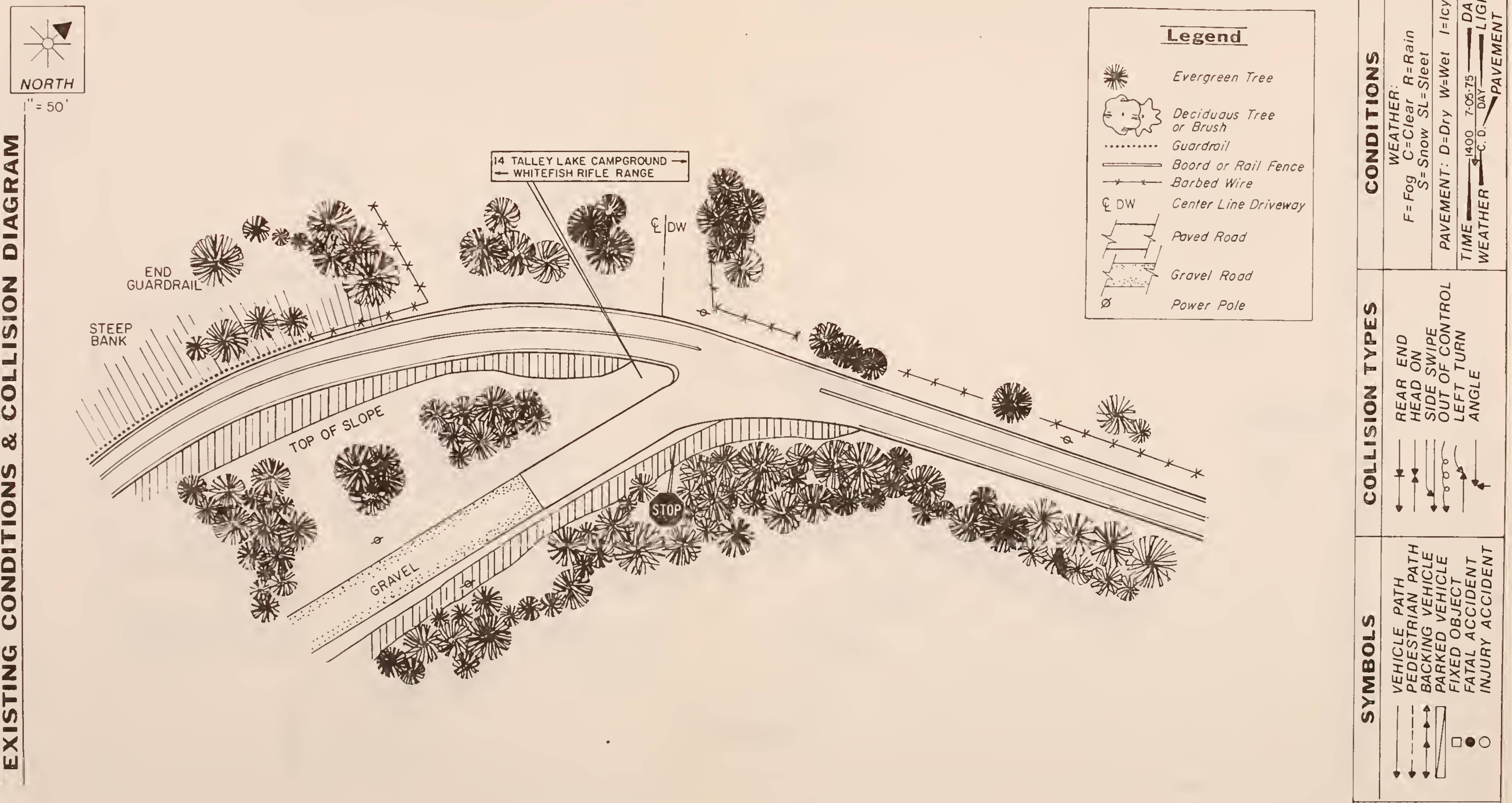
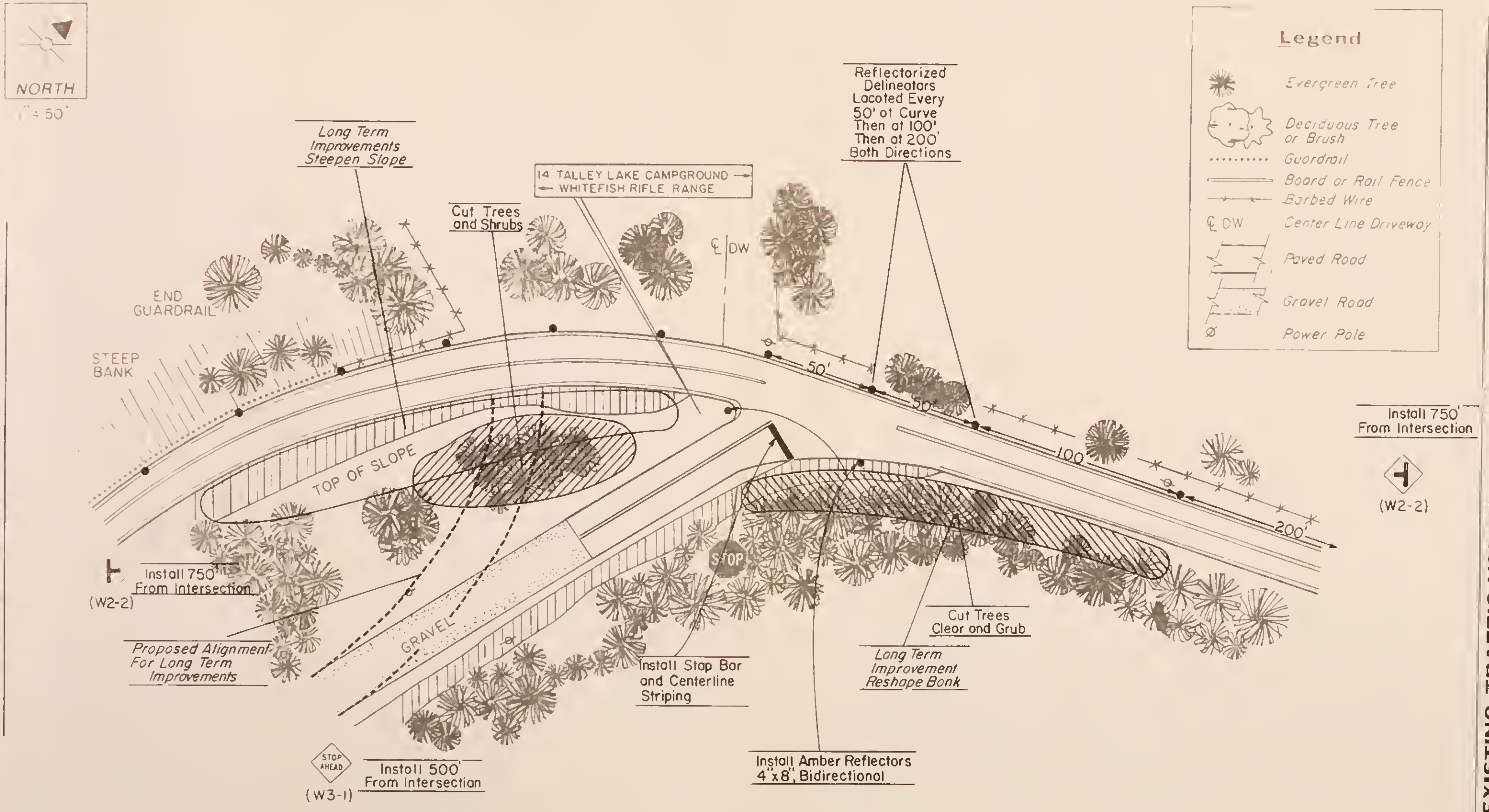


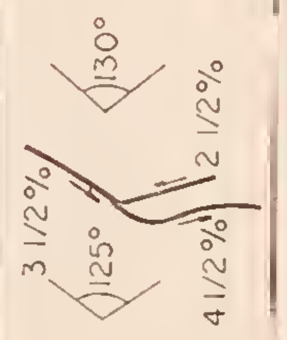
FIGURE NO. 18A

Intersection of
Twin Bridges
Rd. and K.M.
Ranch Rd.

RECOMMENDED IMPROVEMENTS


NORTH
1" = 50'
Long Term Improvements Steepen Slope
14 TALLEY LAKE CAMPGROUND →
← WHITEFISH RIFLE RANGE
Cut Trees and Shrubs
℄ DW
Reflectorized Delineators Located Every 50' at Curve Then at 100', Then at 200' Both Directions
Legend
Evergreen Tree
Deciduous Tree or Brush
Guardrail
Board or Rail Fence
Barbed Wire
℄ DW Center Line Driveway
Paved Road
Gravel Road
Ø Power Pole
END GUARDRAIL
STEEP BANK
TOP OF SLOPE
50'
50'
100
200'
Install 750' From Intersection
(W2-2)
Install 750' From Intersection
(W2-2)
GRAVEL
STOP
Proposed Alignment For Long Term Improvements
Install Stop Bar and Centerline Striping
Cut Trees Clear and Grub
Long Term Improvement Reshape Bank
Install Amber Reflectors 4"x8", Bidirectional
STOP AHEAD
(W3-1)
Install 500' From Intersection

EXISTING GEOMETRICS



EXISTING TRAFFIC VOLUMES

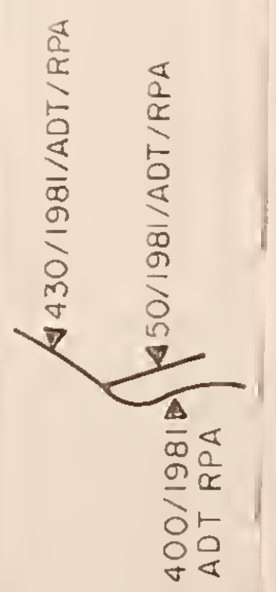


FIGURE NO. 18B

Intersection of
Twin Bridges
Rd. and K.M.
Ranch Rd.

S
I
T
E
19

SITE NUMBER 19

BIG MOUNTAIN ROAD, LOWER SWITCHBACK

A. Location:

Site 19 is located northwest of Whitefish approximately 2.2 miles from the intersection of Big Mountain Road and East Lake Shore Drive. The site is located on the road to the Big Mountain Ski area, and traffic is primarily seasonal.

B. Existing Conditions:

This section of Big Mountain Road has an asphalt pavement surface that is variable in width but is typically 22 feet wide. The tree-lined roadway makes a sharp change in direction as it proceeds up the mountain. Grades increase from 4.5 percent on the lower approach to 8.5 percent on the uphill side of the switchback, and the curve has a radius of approximately 65 feet. The roadway does not have any pavement striping. "Slow" signs are located on each approach to the corner and a curve warning sign and a directional arrow sign are located on the upper approach. A "Keep Right" sign is also located in advance of the turn on the lower approach. However, the 90-degree curve warning sign is not appropriate for the turning maneuver required at the site, and the directional arrow sign is visible only to drivers heading downhill. Sight distance is limited by the terrain and vegetation, as well as by obstructions located within six feet of the roadway. A turnout on the outside of the curve is often used as a parking area by cross-country skiers, and this roadside parking tends to limit the safe space that drivers need to compensate for sliding in the curve during extreme winter road conditions. No advisory speed signs are located within the site; however, speed limit signs are posted at other locations. The terrain and roadway conditions tend to limit speeds. Existing conditions are depicted in the accompanying sketch (Figure 19A) and photographs (Plate 19).

Based on traffic counts conducted by the Montana Department of Highways, the 1981 ADT was determined to be 685 vehicles per day. Daily traffic may exceed 2,000 vehicles during the peak of the ski season. The roadway is also used extensively by bus traffic.

C. Accident History:

There were nine reported accidents at this site. Seven of the nine occurred during the winter ski months, and in six cases the road was icy or snow-packed. The most common type of accident (four) involved a sideswipe. The accident rate at this site is 12.1 accidents per million vehicles entering.

D. Recommendations:

The topography in the area dictates the geometrics of the Big Mountain Road. This site is only one of several sharp turns in this road, but a large

cluster of accidents occurred at this particular location. Short-term improvements can be made that will improve driver awareness and aid the motorist in negotiating this curve.

The recommended improvements are as follows:

1. Remove the brush and small trees on the inside of the curve to improve sight distance.
2. Remove the "Keep Right" sign (R4-7A) on the south approach and remove the "Slow" signs on both approaches. These signs are inconsistent with signing methods outlined in the Manual on Uniform Traffic Control Devices and may confuse the motorist.
3. Remove the existing inappropriate curve warning sign (W1-1) on the north approach. Install the proper curve warning signs (W1-5A) on both the upper and lower approaches 500 feet from the curve. Due to the slower vehicle speeds on this section of road, the 500-foot setback distance was considered appropriate. 15 mph advisory speed plates (W13-1) should be installed with the curve warning signs. According to the AASHO Geometric Highway Design Manual, the design speed of this curve is 15.3 mph based on an existing radius of 65 feet and a superelevation of .08 ft/ft. A ball bank indicator was also used to determine the safe traveling speed for this location. The results of the test indicate that 15 mph is appropriate.
4. Install a double centerline stripe through this curve extending 500 feet back on both approaches.
5. Install no parking signs (R8-3) on the outside of the curve. Parking in this section of road is very dangerous because the parked vehicles on the shoulder of the road act as fixed objects to the other motorists.
6. Install a series of reflectorized delineators on the outside of the curve beginning 500 feet back on the north approach extending through the curve and continuing down the south approach for 500 feet (see Figure 19B).
7. Install icy road warning signs (W8-10) on both approaches at a location 750 feet from the curve. Although this particular sign is not listed in the Manual on Uniform Traffic Control Devices, it is a commonly used and accepted sign by the Montana Department of Highways. This sign, because of its seasonal nature, should be of the hinged variety so the sign can be folded down during the summer months when it does not apply.
8. The existing directional arrow (W1-6) in the curve should be relocated to be clearly visible from the north approach only for a distance of 500 feet. A second directional arrow should also be installed in the curve to be visible from 500 feet back on the south approach.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
1	ea	Remove Keep Right Sign (R4-7A)	$35/ea	$ 35.00
2	ea	Remove Slow Sign	$35/ea	70.00
1	ea	Remove Curve Sign (W1-1)	$35/ea	35.00
2	ea	Install Curve Warning Sign (W1-5A) with Advisory Speed Plate (W13-1)	$180/ea	360.00
2400	lf	Paint Striping 4" Wide Solid	$0.04/lf	96.00
¼	ac	Clearing and Grubbing	$2,000/ac	500.00
13	ea	Install Reflectorized Delineator, 4" x 4", Design "C"	$18/ea	234.00
2	ea	Install Icy Road Warning Sign (W8-10), Hinged Panel Type	$260/ea	520.00
2	ea	Install Directional Arrow (W1-6), 48" x 24"	$163/ea	326.00
4	ea	Install No Parking Sign (R8-3), 24" x 30"	$85/ea	340.00
TOTAL COST:				$2,516.00

BENEFIT/COST RATIO: 2.95

View from the south approach to the lower switchback on Big Mountain Road.

View of the same switchback from the north approach.

ACCIDENT DATA

BIG MOUNTAIN ROAD, LOWER SWITCHBACK

SITE NUMBER 19

ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
2	7	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
	5		1	3		

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
2	2					1	1				3

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
				1					2			1				1		1			1	1	1

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	*Dark*	*Dawn*	*Dusk*
4	4	1	

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
3		1	5	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
8			1

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Side-swipe*	*Non-Col*	*Head-on*	*Backing*
			3			4	2		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
1			4					4

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	1	0	0
Fatality	0	0	0
Property Dam. Only	1	7	0

DETERMINATION OF HAZARD INDEX

Site Number 19 Date November, 1981

Site Description Big Mountain Road, Lower Switchback

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	3.0 acc/yr	46	x 0.164 =	7.54
Accident Rate	12.1 acc/MVE	100	x 0.225 =	22.50
Accident Severity	14,544 dollars	74	x 0.191 =	14.13
Volume/Capacity Ratio	0.34	51	x 0.082 =	4.18
Sight Distance Ratio	0.96 (wt. avg.)	34	x 0.074 =	2.52
Driver Expectancy	4.2 (wt. avg.)	69	x 0.149 =	10.28
Information System Deficiencies	4.2 (wt. avg.)	69	x 0.115 =	7.94

Hazard Index: 69.09

Cost of Recommended Improvements: $2,516.00

Cost Factor: 96

Priority Index = Hazard Index x .75 + Cost Factor x .25

69.09 x .75 + 96 x .25 = 75.82

EXISTING CONDITIONS & COLLISION DIAGRAM

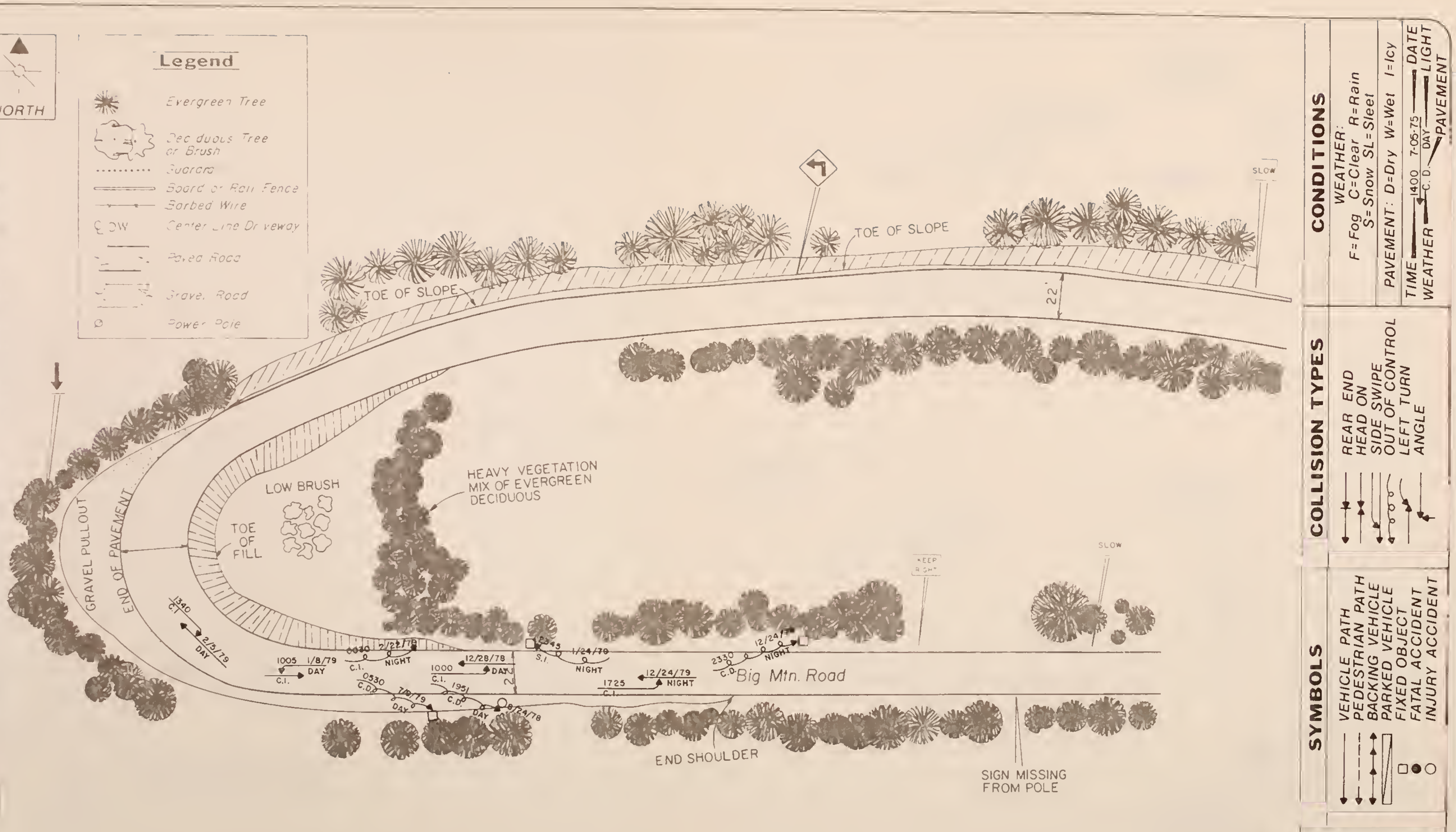


FIGURE NO. 19A

Big Mountain Road, Lower Switchback

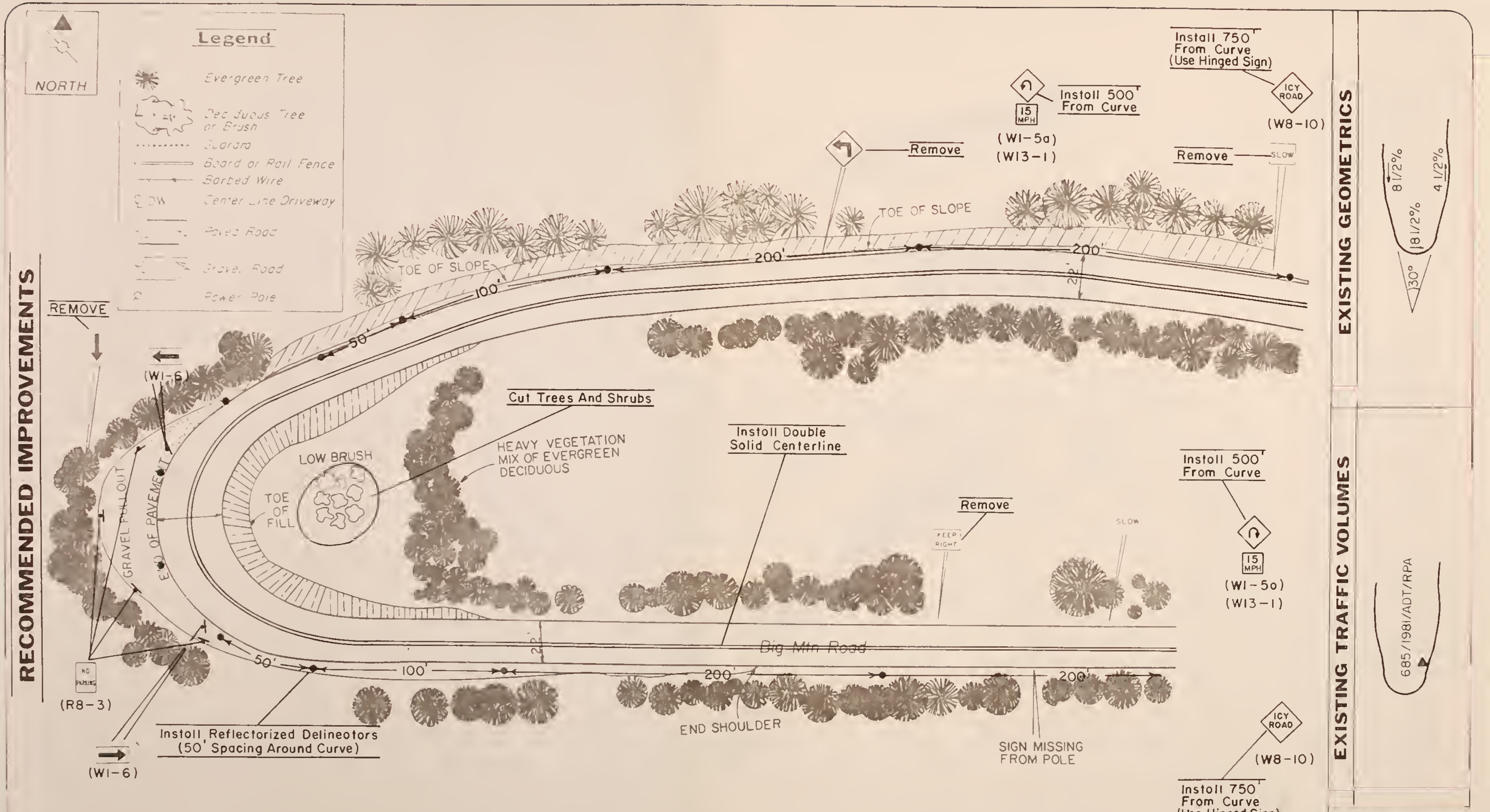


FIGURE NO. 19B

Big Mountain Road, Lower Switchback

SITE 20

SITE NUMBER 20

BIG MOUNTAIN ROAD, UPPER SWITCHBACK

A. Location:

Site 20 is located on Big Mountain Road approximately 3.6 miles from its intersection with East Lakeshore Drive. The site includes the uppermost switchback on Big Mountain Road and is 1.4 miles from the ski area. Traffic at the site is primarily seasonal, with peak traffic occurring around the holidays and during the winter carnival.

B. Existing Conditions:

The roadway has an asphalt pavement surface that is variable in width, but is typically 22 feet wide. The upper switchback makes a 180-degree change in direction, and the centerline radius of the turn is approximately 35 feet. Grades within the section are steep, ranging from a minimum of three to a maximum of 8.3 percent. The grades increase to 16 percent on the inside of the curve where most vehicles travel. The roadway has no pavement striping. The lower approach lacks warning signs, but the upper approach has a 180-degree curve warning sign, which was down at the time of field inspection. Although no advisory speed signs are located within the site, terrain and road conditions limit vehicle speeds. Sight distance is generally limited by the terrain and roadside vegetation. A small "unofficial scenic turnout" is located at the curve. Vehicles parked in the location constitute obstructions and limit space available for emergency maneuvering in the curve. A driveway to the Eagles Nest Subdivision is also located at the curve, and property lines for the subdivision extend near the edge of the present roadway. Building construction activities scheduled for spring, 1982 will alter the land adjacent to the curve significantly. The site is depicted in Figure 20A and Plate 20.

Based on traffic counts conducted by the Montana Department of Highways, the 1981 ADT was determined to be 662 vehicles per day. It is interesting to note that peak traffic volumes are generally experienced when road conditions of the site are at the worst. Accidents at this hairpin turn have been known to stop nearly all traffic on the mountain.

C. Accident History:

Thirteen accidents were reported at this location during the three-year study period. Five of the accidents were sideswipes and two were head-ons. In five cases the vehicle skidded off the road, and in three of the cases, a fixed object (tree) was struck, resulting in injuries. In ten cases the road condition was icy or snow-packed. The accident rate at this location is 18.0 accidents per million vehicles entering.

D. Recommendations:

There are many problems with this switchback section of road. Unfortunately, because of its location on a very steep portion of the mountain, the realignment possibilities are very limited. Several short-term improvements could aid motorists in negotiating this curve.

The short-term improvements are as follows:

1. Install curve warning signs (W1-5a) on both approaches, 500 feet back from the curve on the north approach and 250 feet back on the south approach. Because of the short setback distance on the south approach, an oversized sign (36"x36") should be used. 10 mph advisory speed plates (W13-1) should be installed with the curve warning signs. According to the AASHO Geometric Highway Design Manual, the design speed for this curve is 12 mph, based on an existing radius of 40 feet and a superelevation of .08 ft/ft. A ball bank indicator was also used to determine that 10 mph is the appropriate advisory speed for this location.
2. Install icy road signs (W8-10) on both approaches 750 feet back from the curve. These signs should be hinged so they can be folded down during the summer months when not applicable.
3. Install double solid centerline striping on the curve and extending down both approaches 500 feet.
4. Install a series of reflectorized delineators along the outside of the curve and along both approaches as shown on Figure 20B.
5. Install no parking signs (R8-3) in the vicinity of the rock outcropping on the outside of the curve as shown on Figure 20B.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
2	ea	Install Curve Sign (W1-5a)	$130/ea	$ 260.00
2	ea	Install Hinged Icy Road Warning Sign (W8-10)	$260/ea	520.00
2400	lf	Paint Stripe 4" Wide Solid	$0.04/lf	96.00
16	ea	Install Reflectorized Delineators, 4" x 4", Design "C"	$18/ea	288.00
4	ea	Install No Parking Sign (R8-3), 24" x 30"	$85/ea	340.00

TOTAL COST: $1,504.00

BENEFIT/COST RATIO: 10.70

Long-Term Improvement

Although many sections of the Big Mountain Road meet the requirements for guard rail, this section in particular has a history of accident occurring on the south approach. The steep embankment adjacent to the road could compound the severity of an accident. Therefore, it is recommended that guard rail be installed beginning at the rock outcropping on the outside of the curve and extending down the south approach to the driveway.

Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
700	lf	Guard Rail	$10/lf	$7,000.00
TOTAL LONG-TERM IMPROVEMENT COST:				$7,000.00

View of the upper switchback on Big Mountain Road from the west.

View of the same switchback from above. Note entrance and gate to the Eagles Nest subdivision at right of photo.

ACCIDENT DATA

BIG MOUNTAIN ROAD, UPPER SWITCHBACK

SITE NUMBER 20 ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
5	3	5

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
4				1	3	5

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4	4	3	1								1

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1								1				2		3	3	2						1	

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Daylight	Dark	Dawn	Dusk
11	2		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
3	1	1	8	

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
11	1	1	

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Sideswipe	Non-Col	Head-on	Backing
			3			5	2	3	

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
4	1		5	1				2

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	0	1	2
Fatality	0	0	0
Property Dam. Only	5	2	3

Robert Peccia & Associates

DETERMINATION OF HAZARD INDEX

Site Number 20 Date November, 1981

Site Description Big Mountain Road, Upper Switchback

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	4.3 acc/yr	54	x 0.164 =	8.86
Accident Rate	18.0 acc/MVE	100	x 0.225 =	22.50
Accident Severity	15,069 dollars	75	x 0.191 =	14.33
Volume/Capacity Ratio	0.24	41	x 0.082 =	3.36
Sight Distance Ratio	0.95 (wt. avg.)	38	x 0.074 =	2.81
Driver Expectancy	5.8 (wt. avg.)	97	x 0.149 =	14.45
Information System Deficiencies	6.0 (wt. avg.)	100	x 0.115 =	11.50

Hazard Index: 77.81

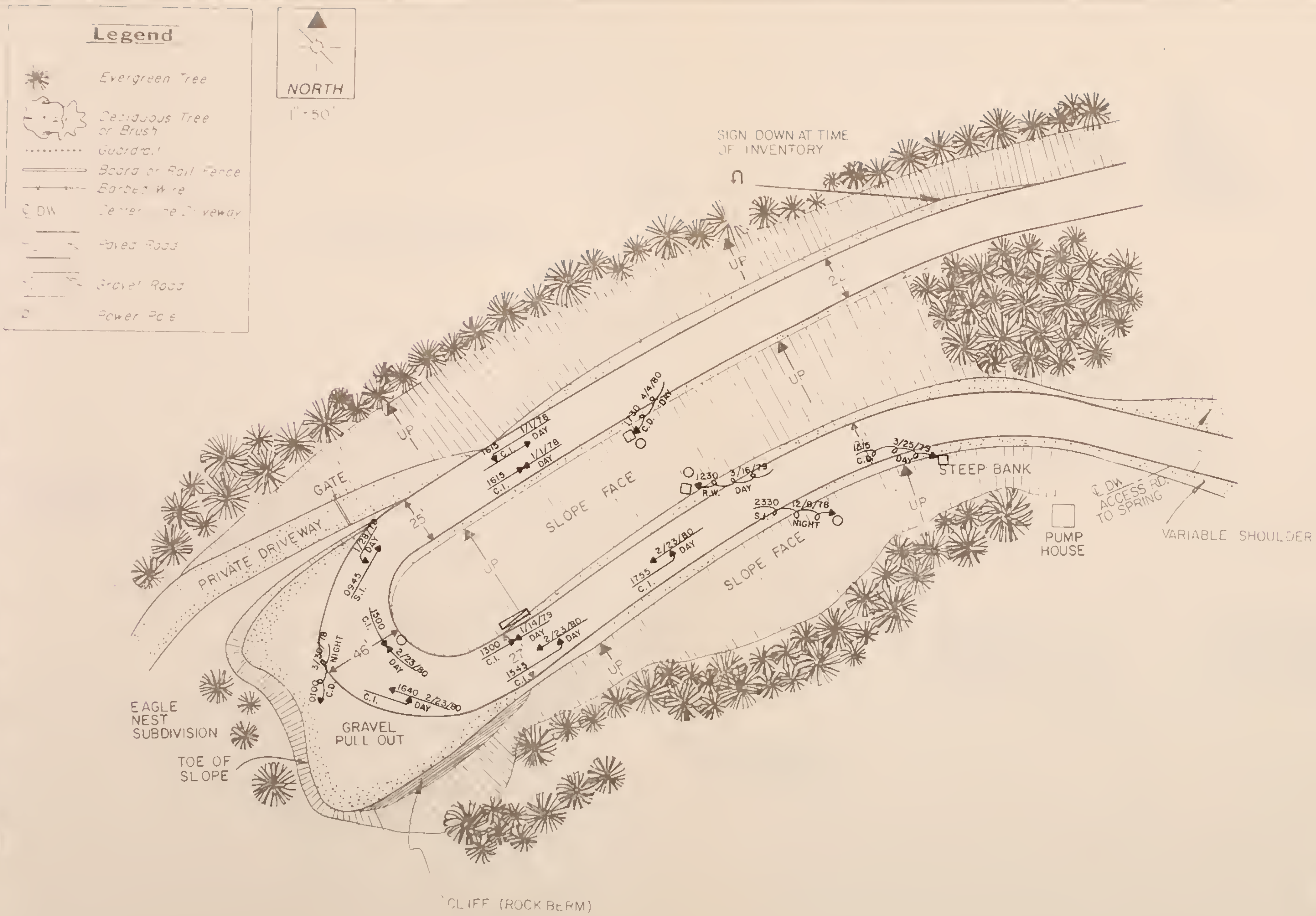
Cost of Recommended Improvements: $1,504.00

Cost Factor: 98

Priority Index = Hazard Index x .75 + Cost Factor x .25

77.81 x .75 + 98 x .25 = 82.86

EXISTING CONDITIONS & COLLISION DIAGRAM



CONDITIONS

WEATHER:
F = Fog C = Clear R = Rain
S = Snow SL = Sleet

PAVEMENT: D = Dry W = Wet I = Icy

TIME 1400
DATE 7-05-75
LIGHT DAY
WEATHER C.
PAVEMENT D.

COLLISION TYPES

REAR END
HEAD ON
SIDE SWIPE
OUT OF CONTROL
LEFT TURN
ANGLE

SYMBOLS

VEHICLE PATH
PEDESTRIAN PATH
BACKING VEHICLE
PARKED VEHICLE
□ FIXED OBJECT
● FATAL ACCIDENT
○ INJURY ACCIDENT

FIGURE NO. 20A

Big Mountain
Road, Upper
Switchback

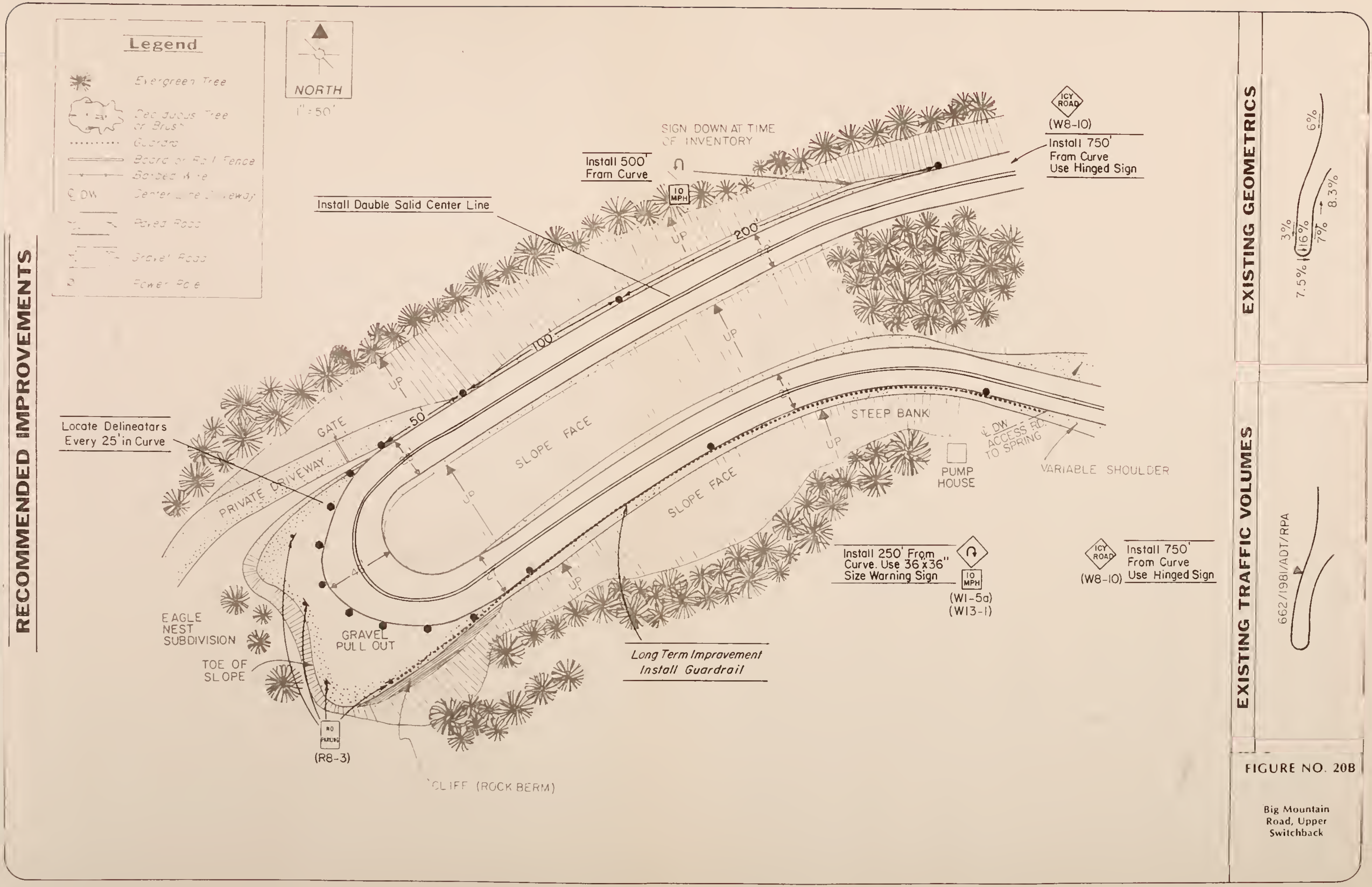


FIGURE NO. 20B

Big Mountain Road, Upper Switchback

SITE
21

SITE NUMBER 21

EAST LAKE SHORE DRIVE AT HELL ROARING CREEK

A. Location:

Site 21 consists of a .2 mile long series of reverse curves located on East Lake Shore Drive approximately five miles northwest of Whitefish. The site at Hell Roaring Creek is located 3.3 miles northwest of the Big Mountain Road turnoff in heavily wooded terrain along Whitefish Lake.

B. Existing Conditions:

The roadway has an asphalt pavement surface that is typically 22 feet wide. Grades on the northwest approach range from 5.2 to 8.5 percent, whereas those on the southeast approach are between 1.5 and 2.5 percent. The change in direction throughout the site is summarized in Figure 21A. The centerline striping through the site is poor; however, the roadway has been spotted to designate the centerline for future striping. The roadway is generally signed with 25 mph speed limit signs, but no speed limit signs were located within the site. Warning signs consisting of a 90-degree curve sign and a directional arrow are located on each approach to the site. Two sections of non-reflectorized metal guard rail are located within the site; a 312-foot-long section along the first curve on the northwest approach and a 230-foot-long section on the first curve of the southeast approach. Sight distance is limited throughout the site by the combination of curves, steep road cuts, and thick roadside vegetation. The beginnings of both guard rail sections and numerous trees present obstructions to drivers travelling toward the southeast. These obstructions are located within two feet of the roadway in numerous places along the site. Plates 21A and 21B depict site characteristics.

Traffic counts conducted by Robert Peccia and Associates during November, 1981 indicate that the 1981 ADT is 179 vehicles per day. The roadway generally serves residents on the east side of Whitefish Lake. Many residents are seasonal, and traffic in the summer is expected to be somewhat greater than the ADT.

C. Accident History:

There were five accidents reported at this location during the three-year study period. Four of the five accidents occurred during clear and dry conditions. Two accidents were sideswipes and the other three were single-vehicle accidents in which the vehicles left the road and struck trees. There was only one injury accident at this location. The accident rate at this site is 24.4 accidents per million vehicles entering.

D. Recommendations:

This section is made up of three curves. The inside curve is at the

crossing over Hell Roaring Creek. The east and west curves have common problems, sharp outside curves with limited sight distance. The sight distance can be improved through a long-term improvement, and this will be discussed after the short-term improvements.

The short-term improvements are as follows:

1. Install a series of chevron signs (W1-8) through the project delineating the curves as shown in Figure 21B. The 18" x 24" signs should be used.
2. Remove the directional arrows (W6-1) from the east and west curve sections at this site.
3. Maintain the centerline and shoulder striping through this section.
4. Remove the curve warning signs (W1-2) from both ends of the site and install winding road signs (W1-5) 750 feet back from the initial curve. 15 mph advisory speed plates (W13-1) should accompany the winding road signs. Based on the AASHO Geometric Highway Design Manual, the design speed for the Hell Roaring Creek curve is approximately 15 mph, based on an existing radius of 55 feet and a superelevation of .08 ft/ft. A ball bank indicator was also used to determine that the appropriate advisory speed for this location is 15 mph.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
24	ea	Install Chevron Sign (W1-8) (18" x 24")	$105/ea	$2,520.00
2	ea	Remove Directional Arrow (W1-6), 48" x 24"	$35/ea	70.00
2	ea	Remove Curve Warning Sign (W1-2)	$35/ea	70.00
2	ea	Install Winding Road Warning Sign (W1-5)	$130/ea	260.00
6	ea	Install Reflectorized Delineators, 4"x4", Design "A"	$15.50/ea	93.00
TOTAL COST:				$3,013.00

BENEFIT/COST RATIO: 3.63

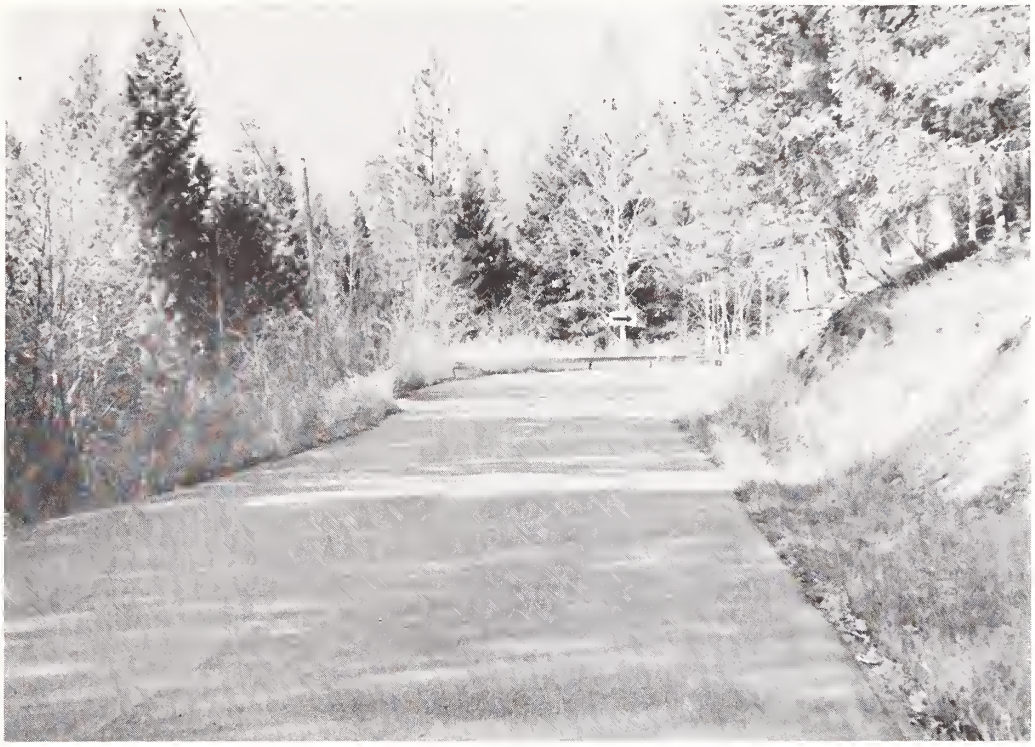
Long-Term Improvements:

The inside of the east and west curves should be cut back and reshaped to provide adequate sight distance. Approximately 1,500 cubic yards of excavation is required in the east curve and 2,200 cubic yards in the west curve. The material that is generated could be placed on the outside of the Hell Roaring Creek curve. The culvert under the road would also have to be extended uphill 50 feet (see Figure 21B).

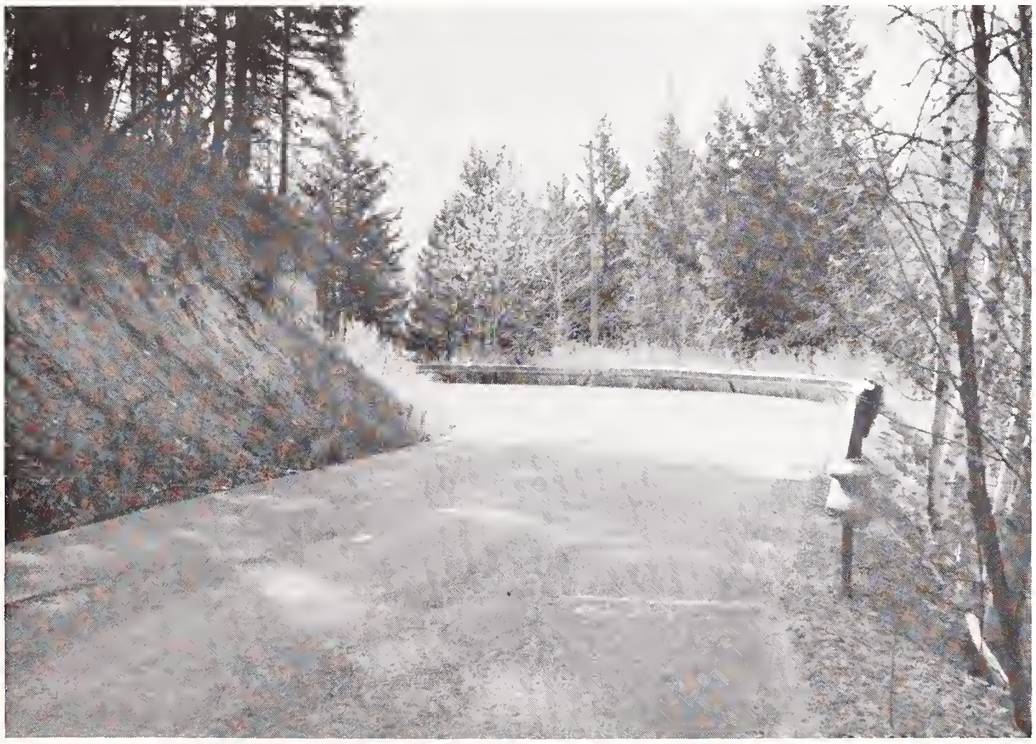
The two sections of existing, damaged guard rail should be removed, since they are near the end of their service life. One continuous section of guard rail should be used to replace these two existing sections.

Long-Term Improvement Cost Estimate

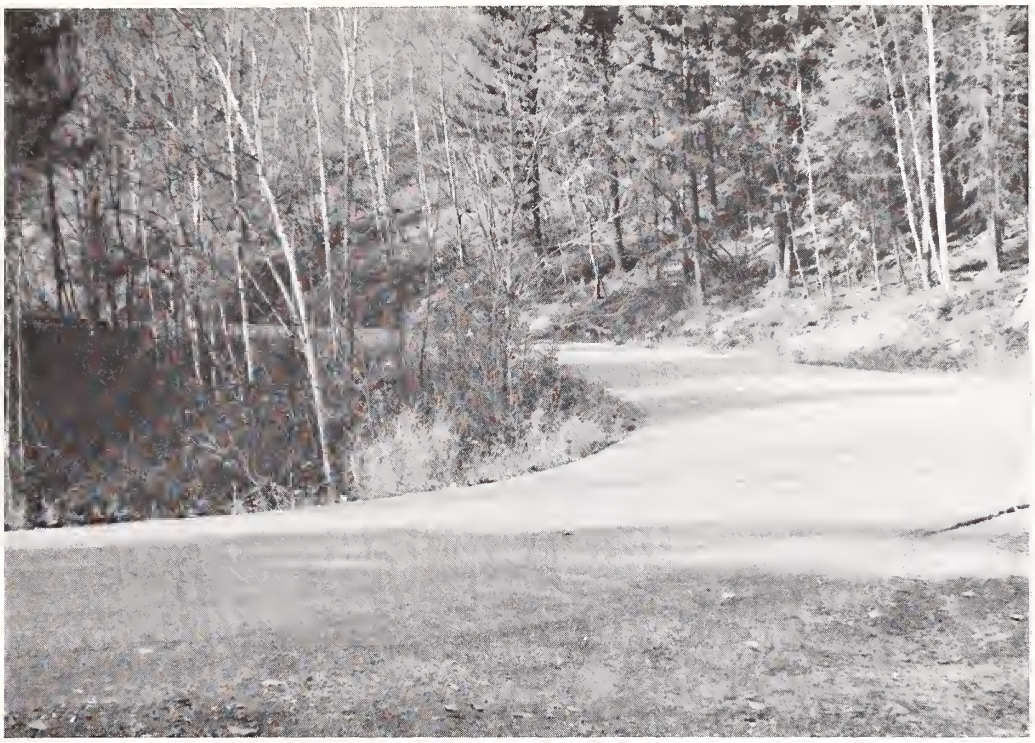
Quantity	Unit	Item Description	Unit Price	Total Price
3700	cy	Excavation and Embankment	$6/cy	$22,200.00
50	lf	36" Corrugated Metal Pipe	$40/lf	200.00
542	lf	Remove Guard Rail	$2.50/lf	1,355.00
800	lf	Install Guard Rail	$10/lf	8,000.00
TOTAL LONG-TERM IMPROVEMENT COST:				$31,755.00



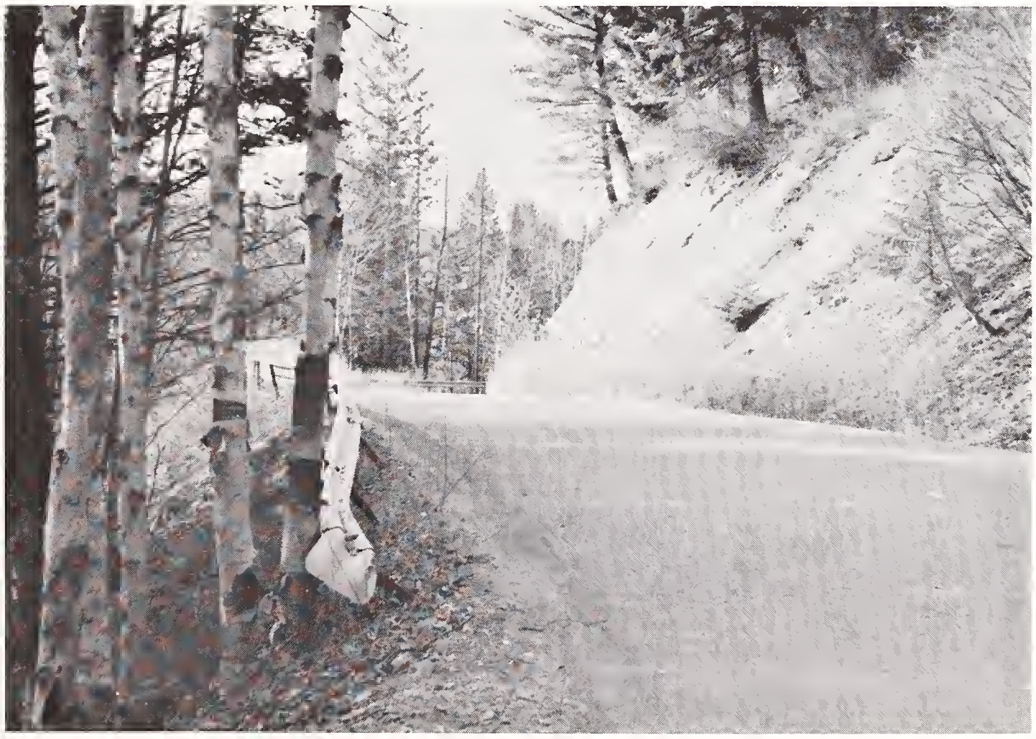
View of the east approach to the Hell Roaring Creek curve.



Eastbound view of the easternmost curve. Note limited sight distance due to the bank at the left of the photo.



View of the curve at Hell Roaring Creek. Note limited sight distance due to trees and shrubs on inside of curve.



View of the west approach as seen from the creek. Note damaged guard rail.

ACCIDENT DATA

EAST LAKE SHORE DRIVE AT HELL ROARING CREEK

SITE NUMBER 21 ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
0	4	1

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
3			1			1

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
				1	2			1			1

NUMBER OF ACCIDENTS BY TIME OF DAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1											2	1				1							

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
3	2		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
4		1		

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
4	1		

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Obj.	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
			2			2	1		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	Drinking	Reckless Driving	Speed	Right-of Way	Improper Passing	Improper Backing	Improper Turning	Other
	2		1	1				1

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	0	1	0
Fatality	0	0	0
Property Dam. Only	0	3	1

DETERMINATION OF HAZARD INDEX

Site Number 21 Date November, 1981

Site Description East Lake Shore Drive at Hell Roaring Creek

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	1.7 acc/yr	34	x 0.164 =	5.58
Accident Rate	24.4 acc/MVE	100	x 0.225 =	22.50
Accident Severity	15,280 dollars	76	x 0.191 =	14.52
Volume/Capacity Ratio	0.07	22	x 0.082 =	1.80
Sight Distance Ratio	0.83 (wt. avg.)	48	x 0.074 =	3.55
Driver Expectancy	5.5 (wt. avg.)	92	x 0.149 =	13.71
Information System Deficiencies	5.2 (wt. avg.)	86	x 0.115 =	9.89

Hazard Index: 71.55

Cost of Recommended Improvements: $3,013.00

Cost Factor: 84

Priority Index = Hazard Index x .75 + Cost Factor x .25

71.55 x .75 + 84 x .25 = 74.66

EXISTING CONDITIONS & COLLISION DIAGRAM

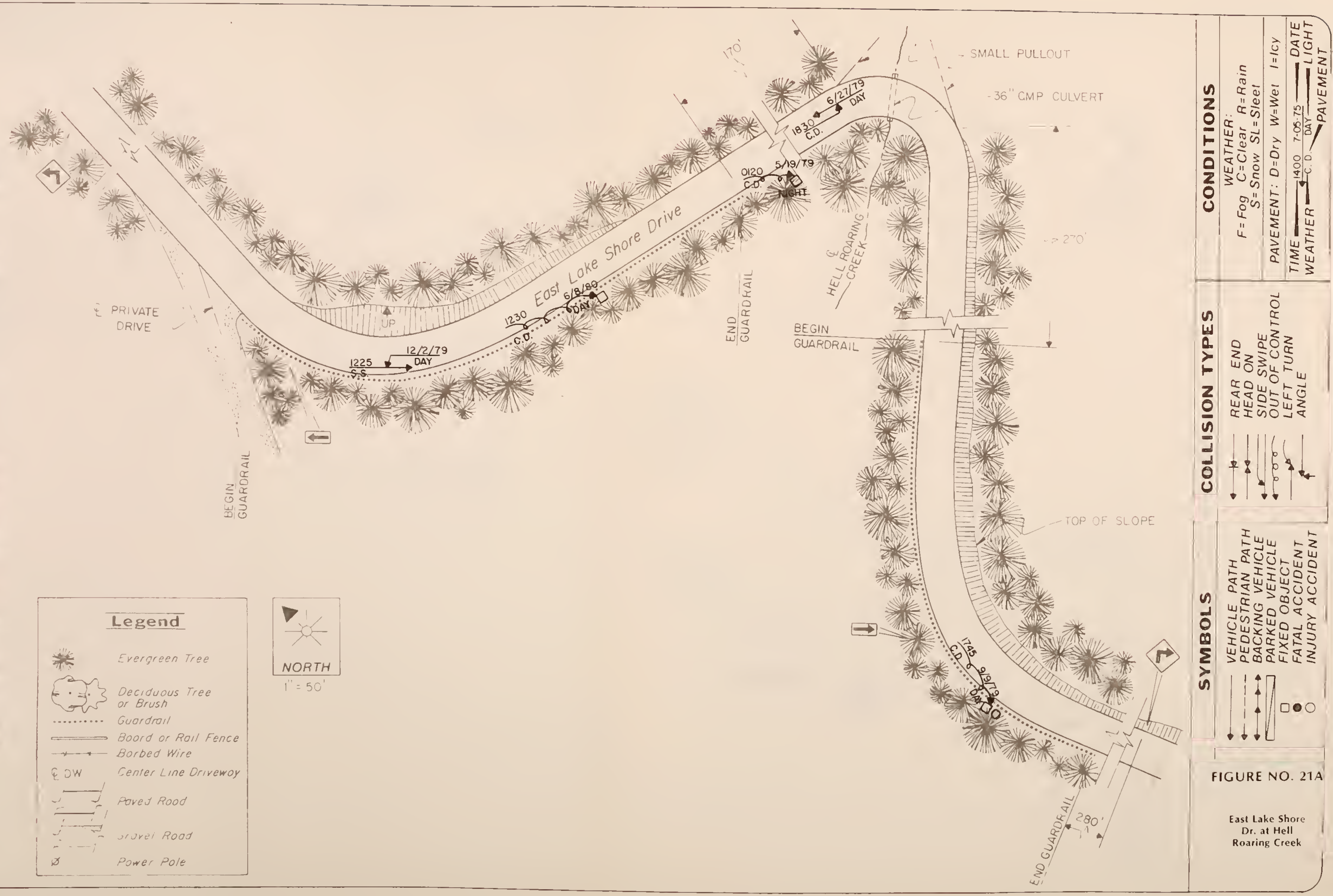


FIGURE NO. 21A

East Lake Shore Dr. at Hell Roaring Creek

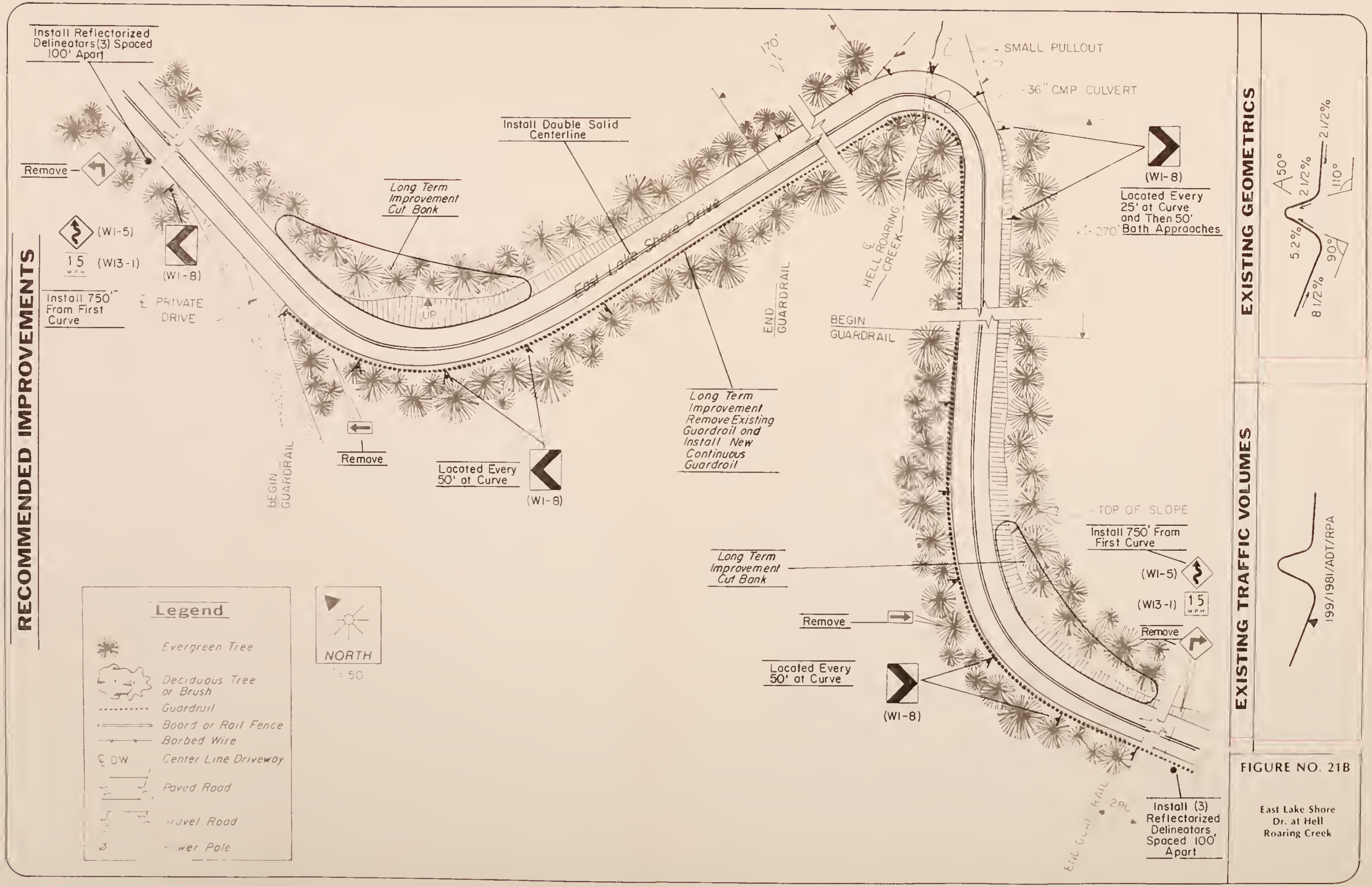


FIGURE NO. 21B

East Lake Shore Dr. at Hell Roaring Creek

S
I
T
E
22

SITE NUMBER 22

EAST LAKE SHORE DRIVE

A. Location:

Site 22 includes a winding section of East Lake Shore Drive approximately six miles northwest of Whitefish. The exact location of the site is 4.0 miles northwest of Big Mountain Road intersection. The roadway is flanked by on the east by a steep rock cut and on the west by a steep slope and Whitefish Lake.

B. Existing Conditions:

East Lake Shore Drive is a 22-foot-wide, asphalt-surfaced roadway. The roadway is essentially a straight section; however, several minor curves are contained in the section, primarily due to the rocky nature of the terrain. The road grade falls consistently at three percent through the section. The centerline striping within the section is badly in need of repainting, and there are presently no warning signs located within the site. The posted speed limit for East Lake Shore Drive is 25 mph; however, no speed limit signs are located within this section of roadway. A non-reflectorized metal guard rail is located on the lake side of the road. Due to the terrain, the guard rail is placed within two feet of the roadway edge. Power poles are also located near the edge of the road. Sight distance through the section is adequate. See Figure 22A and Plate 22 for existing site conditions.

Based on machine counts of 24-hour traffic volumes conducted by Robert Peccia and Associates during November, 1981, it was determined that the 1981 ADT is 199 vehicles per day.

C. Accident History:

Four accidents were reported at this location during the three-year study period. All were single-vehicle accidents, and two involved injuries. In each case the weather was clear and the pavement dry. Excessive speed was involved in two instances. The accident rate at this location is 19.5 accidents per million vehicles entering.

D. Recommendations:

Although this section of road has several minor curves, the sight distance is good and the changes in alignment are not severe. The greatest possibility of a serious accident along East Lake Shore Drive is presented by the steep nature of the lake shore terrain coupled with a lack of guard rail. Guard rail has been installed along this section of roadway; however, the present guard rail is damaged in places and is not securely anchored to the hillside.

The following improvements are recommended:

1. Install reflectorized delineators in both sides of the roadway as shown on Figure 22B.
2. Install two 25 mph speed limit signs (R2-1) on both approaches to this site.
3. Maintain the existing centerline and shoulder striping properly.

Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
16	ea	Reflectorized Delineator 4" x 4", Design "F"	$15.50/ea	$248.00
2	ea	Install 25 mph Speed Limit Sign (R2-1), 24" x 30"	$130/ea	260.00
TOTAL COST:				$508.00

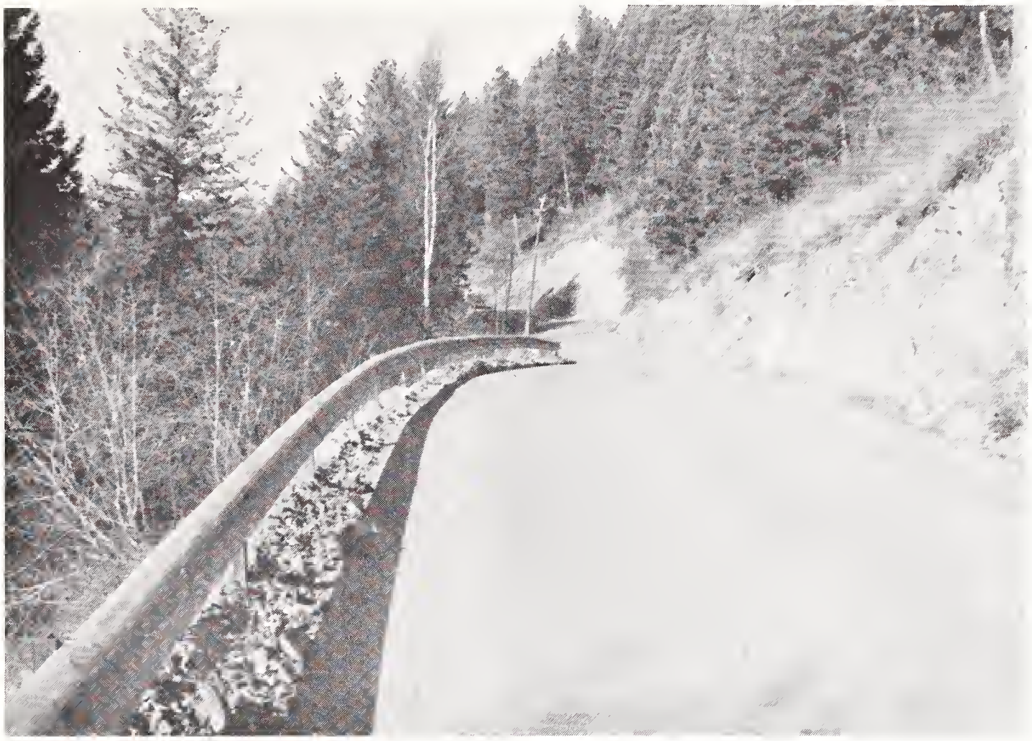
BENEFIT/COST RATIO: 7.40

Long-Term Improvements

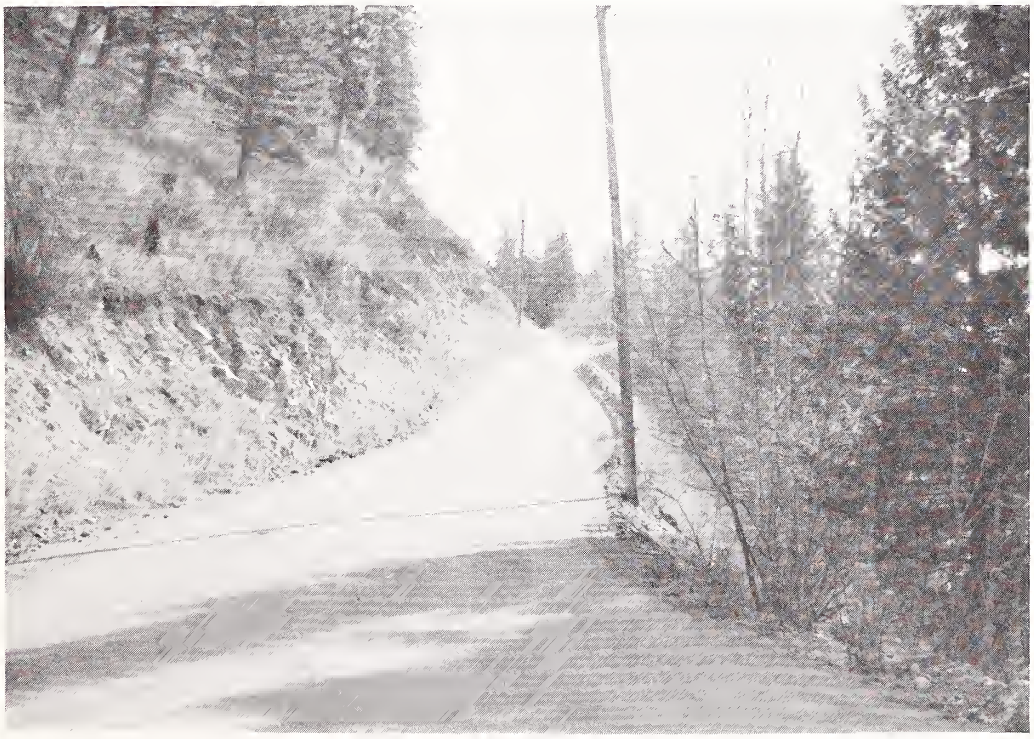
The steep bank on the lake side of this road constitutes the greatest potential for a serious accident. The existing guard rail is damaged and near the end of its service life. Therefore, it is recommended to replace the existing 385 feet of guard rail with a 500-foot-long new section that is properly anchored to the hillside. The guard rail should be reflectorized and located as shown on Figure 22B.

Long-Term Improvement Cost Estimate

Quantity	Unit	Item Description	Unit Price	Total Price
385	lf	Remove Guard Rail	$2.50/lf	$ 963.00
500	lf	Install Guard Rail	$10/lf	5,000.00
TOTAL LONG-TERM IMPROVEMENT COST:				$5,963.00



Westbound view along East Lakeshore Drive.



Northwest approach to the curve on East Lakeshore Drive. Note steep bank on left and proximity of power pole to edge of road on right.

ACCIDENT DATA

EAST LAKE SHORE DRIVE

SITE NUMBER 22

ACCIDENT PERIOD 1978 - 1980

NUMBER OF ACCIDENTS BY YEAR

1978	1979	1980
2	2	0

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
2	1					1

NUMBER OF ACCIDENTS BY MONTH

Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
					2		1	1			

NUMBER OF ACCIDENTS BY TIME OF DAY

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
										1								2		1			

NUMBER OF ACCIDENTS BY LIGHT CONDITIONS

Day-light	*Dark*	*Dawn*	*Dusk*
3	1		

NUMBER OF ACCIDENTS BY ROAD CONDITIONS

Dry	*Wet*	*Snow*	*Ice*	*Other*
4				

NUMBER OF ACCIDENTS BY WEATHER CONDITIONS

Clear	*Rain*	*Snow*	*Fog*
4			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	*Turn*	*Rear End*	*Fixed Obj.*	*Ped.*	*Animal*	*Side-swipe*	*Non-Col*	*Head-on*	*Backing*
			1				3		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Ap. Violation	*Drinking*	*Reckless Driving*	*Speed*	*Right-of Way*	*Improper Passing*	*Improper Backing*	*Improper Turning*	*Other*
2			2					

NUMBER OF ACCIDENTS BY SEVERITY

	1978	1979	1980
Injury	2	0	0
Fatality	0	0	0
Property Dam. Only	0	2	0

DETERMINATION OF HAZARD INDEX

Site Number 22 Date November, 1981

Site Description East Lake Shore Drive

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	1.3 acc/yr	31	x 0.164 =	5.08
Accident Rate	19.5 acc/MVE	100	x 0.225 =	22.50
Accident Severity	10,175 dollars	64	x 0.191 =	12.22
Volume/Capacity Ratio	0.07	22	x 0.082 =	1.80
Sight Distance Ratio	3.33 (wt. avg.)	0	x 0.074 =	0
Driver Expectancy	1.3 (wt. avg.)	22	x 0.149 =	3.28
Information System Deficiencies	4.0 (wt. avg.)	67	x 0.115 =	7.71

Hazard Index: 52.59

Cost of Recommended Improvements: $508.00

Cost Factor: 98

Priority Index = Hazard Index x .75 + Cost Factor x .25

52.59 x .75 + 98 x .25 = 63.94

EXISTING CONDITIONS & COLLISION DIAGRAM

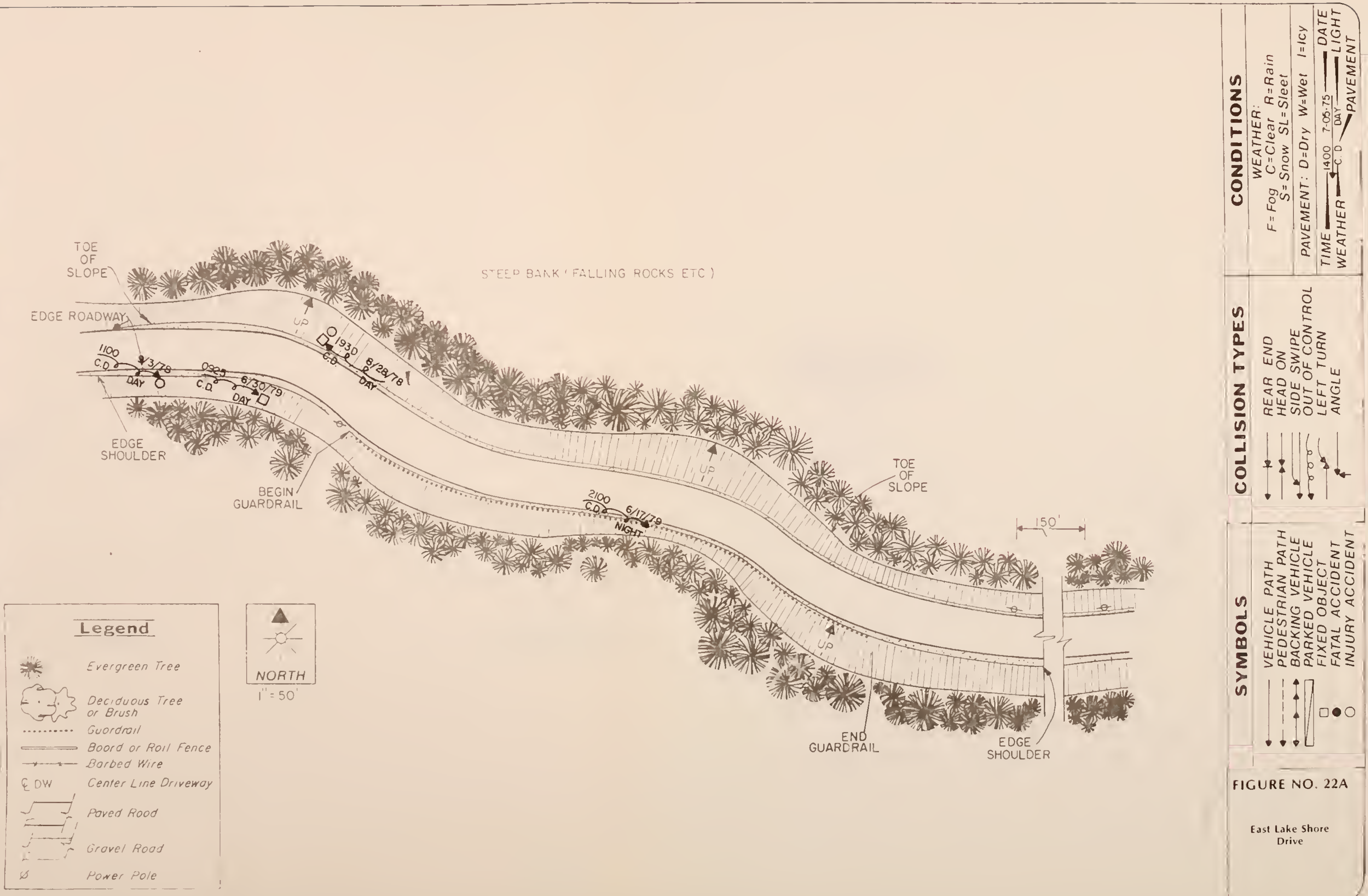
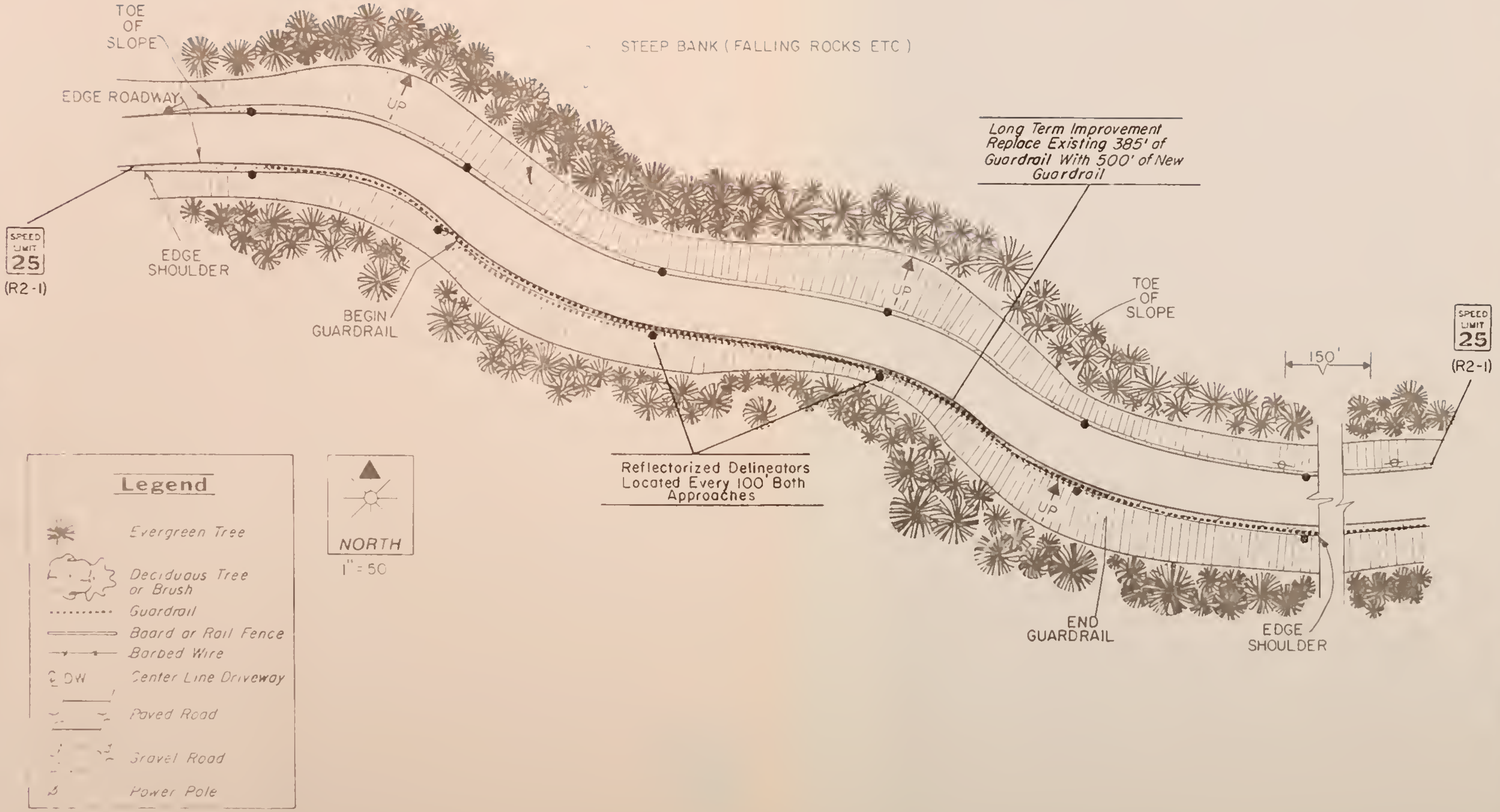


FIGURE NO. 22A

East Lake Shore Drive

RECOMMENDED IMPROVEMENTS



EXISTING GEOMETRICS

EXISTING TRAFFIC VOLUMES

FIGURE NO. 22B

East Lake Shore Drive

BIBLIOGRAPHY

V

BIBLIOGRAPHY

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APPENDIX "A"

VI

DETERMINATION OF HAZARD INDEX

Site Number ____________________ Date ____________________

Site Description ____

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	________ acc/yr	________	x 0.164 =	________
Accident Rate	________ acc/MVE	________	x 0.225 =	________
Accident Severity	________ dollars	________	x 0.191 =	________
Volume/Capacity Ratio	________	________	x 0.082 =	________
Sight Distance Ratio	________ (wt. avg.)	________	x 0.074 =	________
Driver Expectancy	________ (wt. avg.)	________	x 0.149 =	________
Information System Deficiencies	________ (wt. avg.)	________	x 0.115 =	________

Hazard Index: ________________

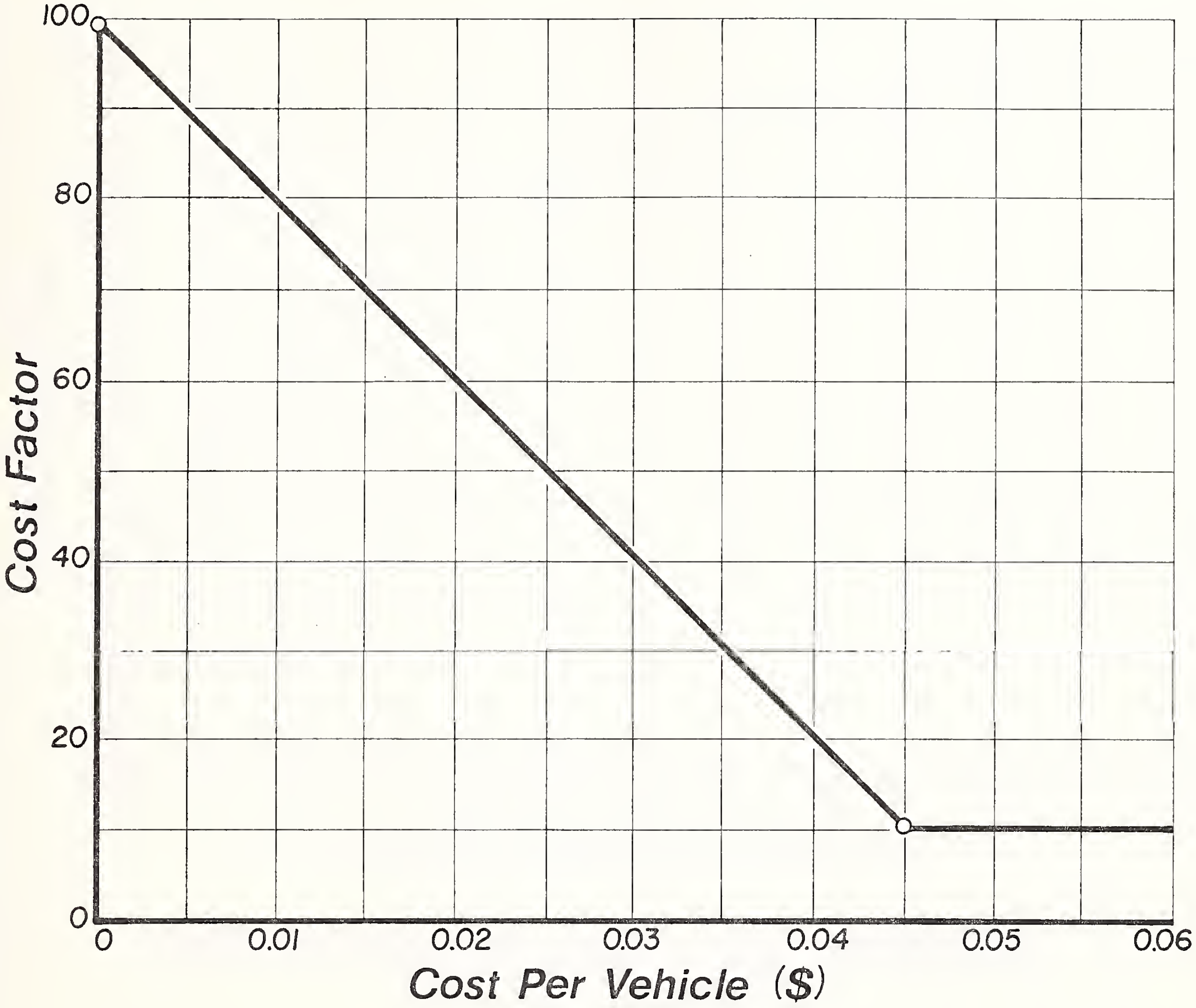
Cost of Recommended Improvements: ________________

Cost Factor: ________________

Priority Index = Hazard Index x .75 + Cost Factor x .25

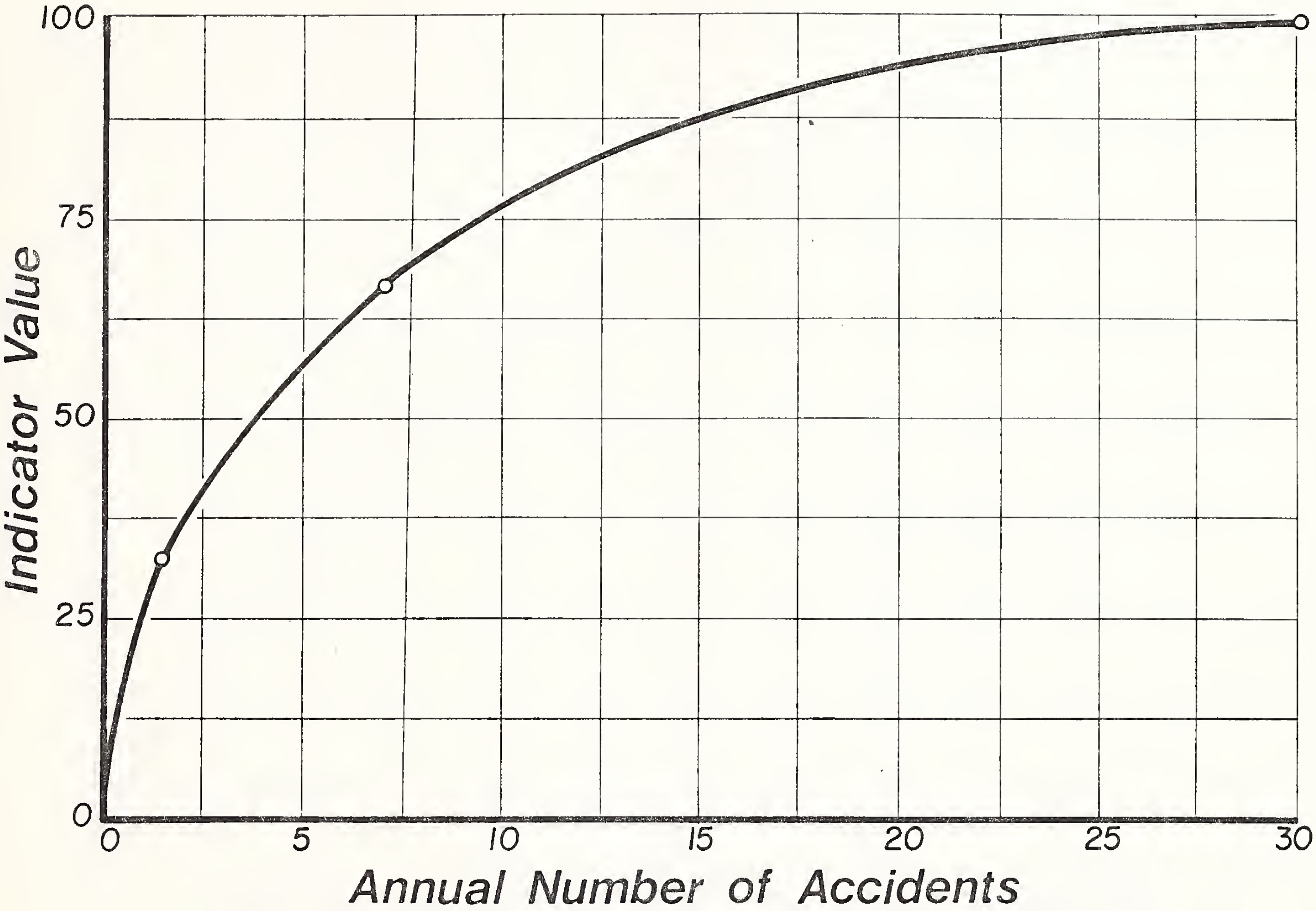
________ x .75 + ________ x .25 = ________

FIGURE A1



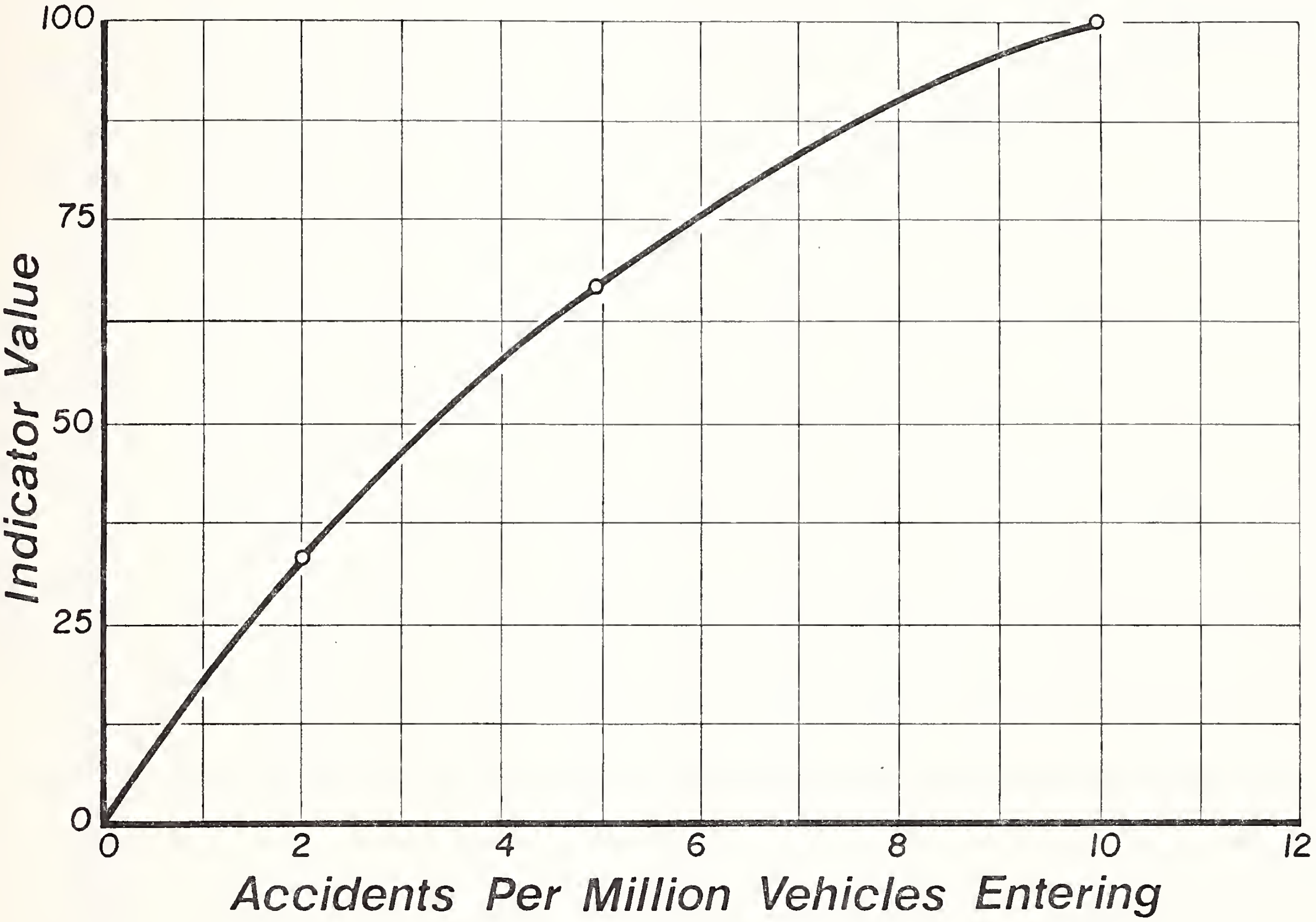
FORM FOR DETERMINATION
OF COST FACTOR

FIGURE A2



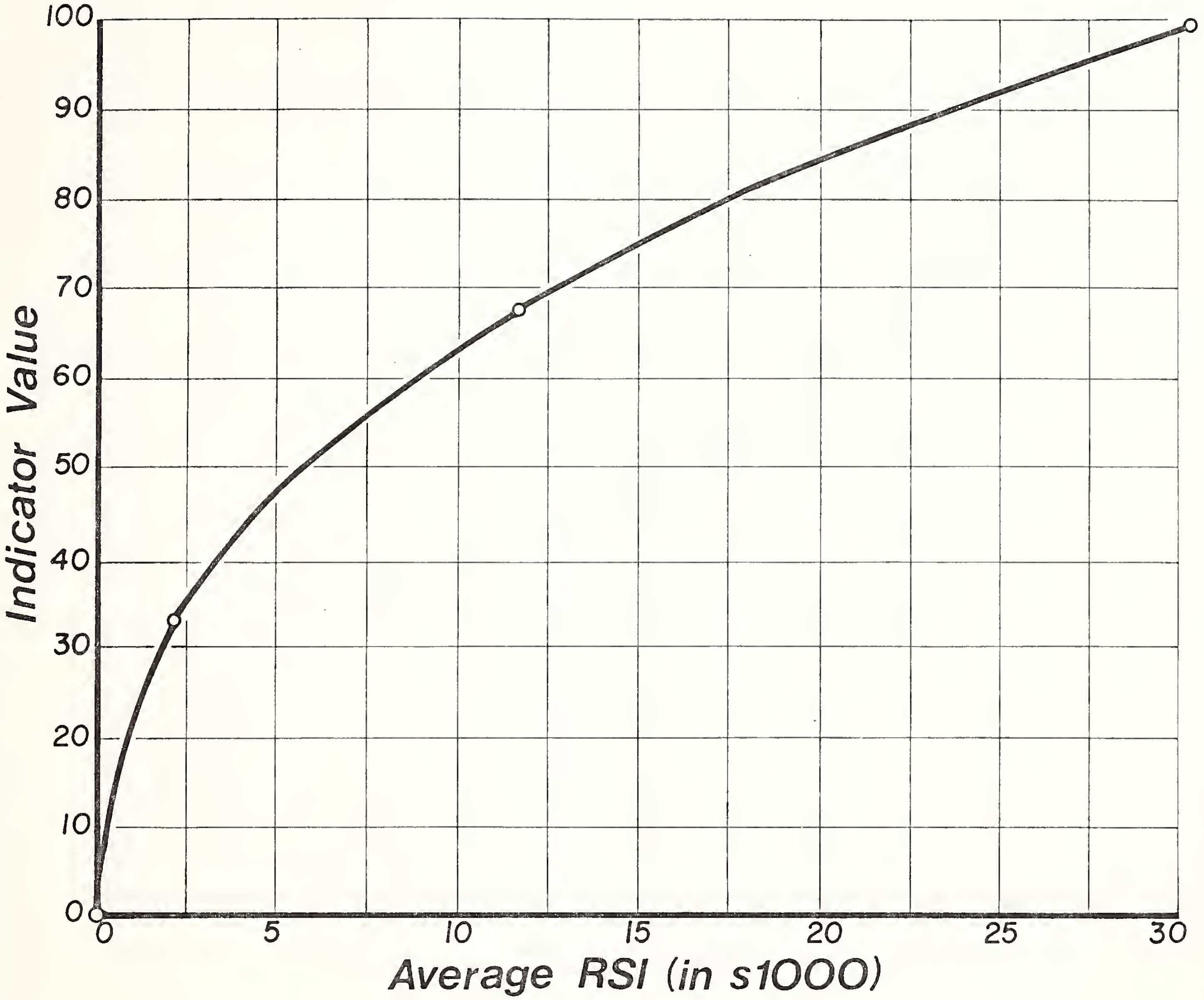
INDICATOR VALUES FOR NUMBER OF ACCIDENTS

FIGURE A3



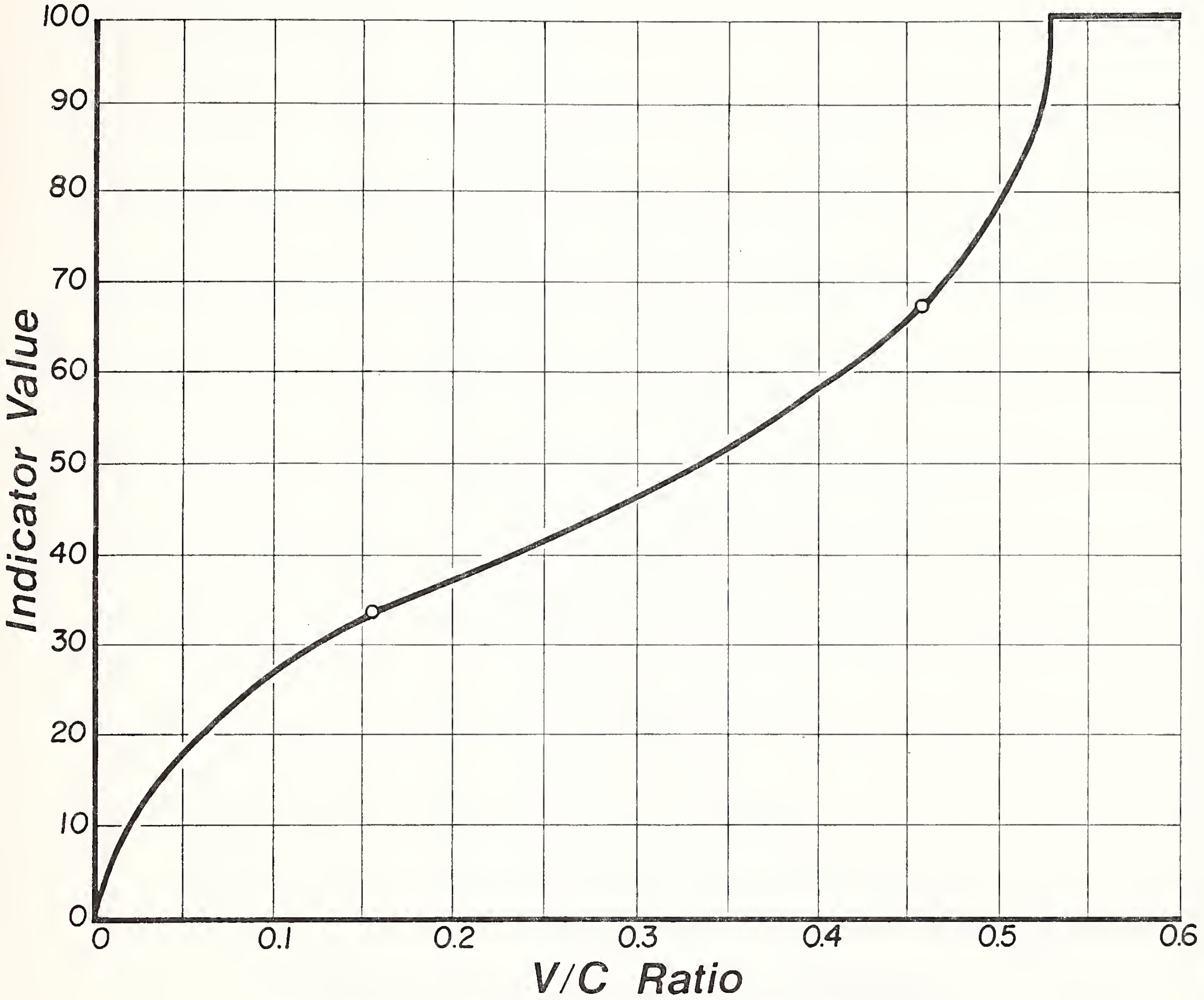
INDICATOR VALUES FOR ACCIDENT RATE

FIGURE A4



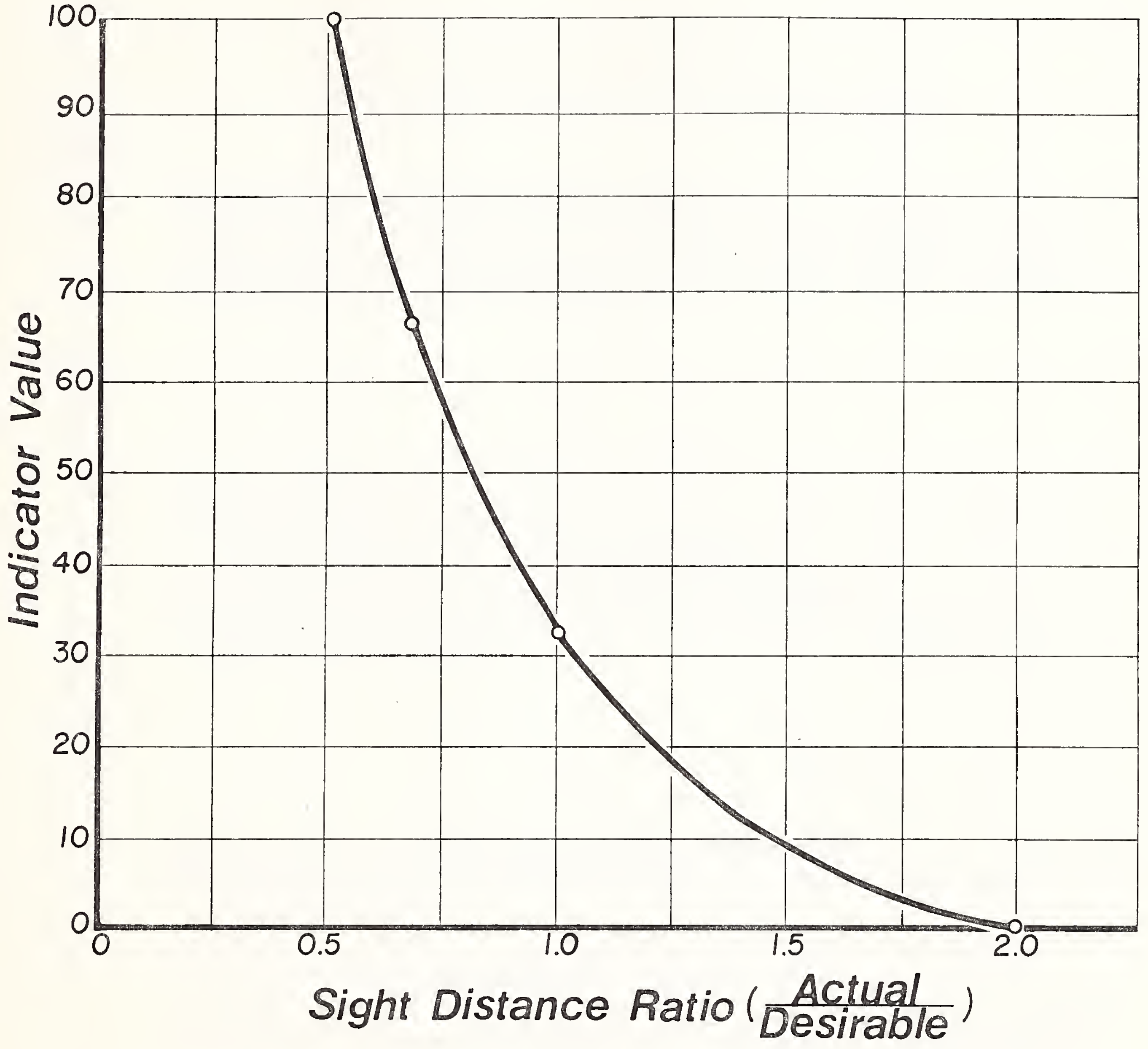
INDICATOR VALUE FOR ACCIDENT SEVERITY

FIGURE A5



INDICATOR VALUES FOR
V/C RATIO

FIGURE A6



INDICATOR VALUES FOR SIGHT DISTANCE

FIGURE A7

DRIVER EXPECTANCY PROBLEMS RATING FORM

Ratings

0 Nothing unexpected or unusual at this location.
Actions required (if any) entirely consistent with driving strategy on approach.
Standard geometry, with pathway(s) for intended movement(s) clearly evident.
No intereferences by other traffic likely.

1

2

3 Situation somewhat unexpected.
Driver must be alert, but should be able to respond adequately at "last minute" to most combinations of adverse circumstances.
Some initial confusion on intended path(s) or movement(s).
Interference from other traffic may create some degree of confusion or uncertainty for average driver.

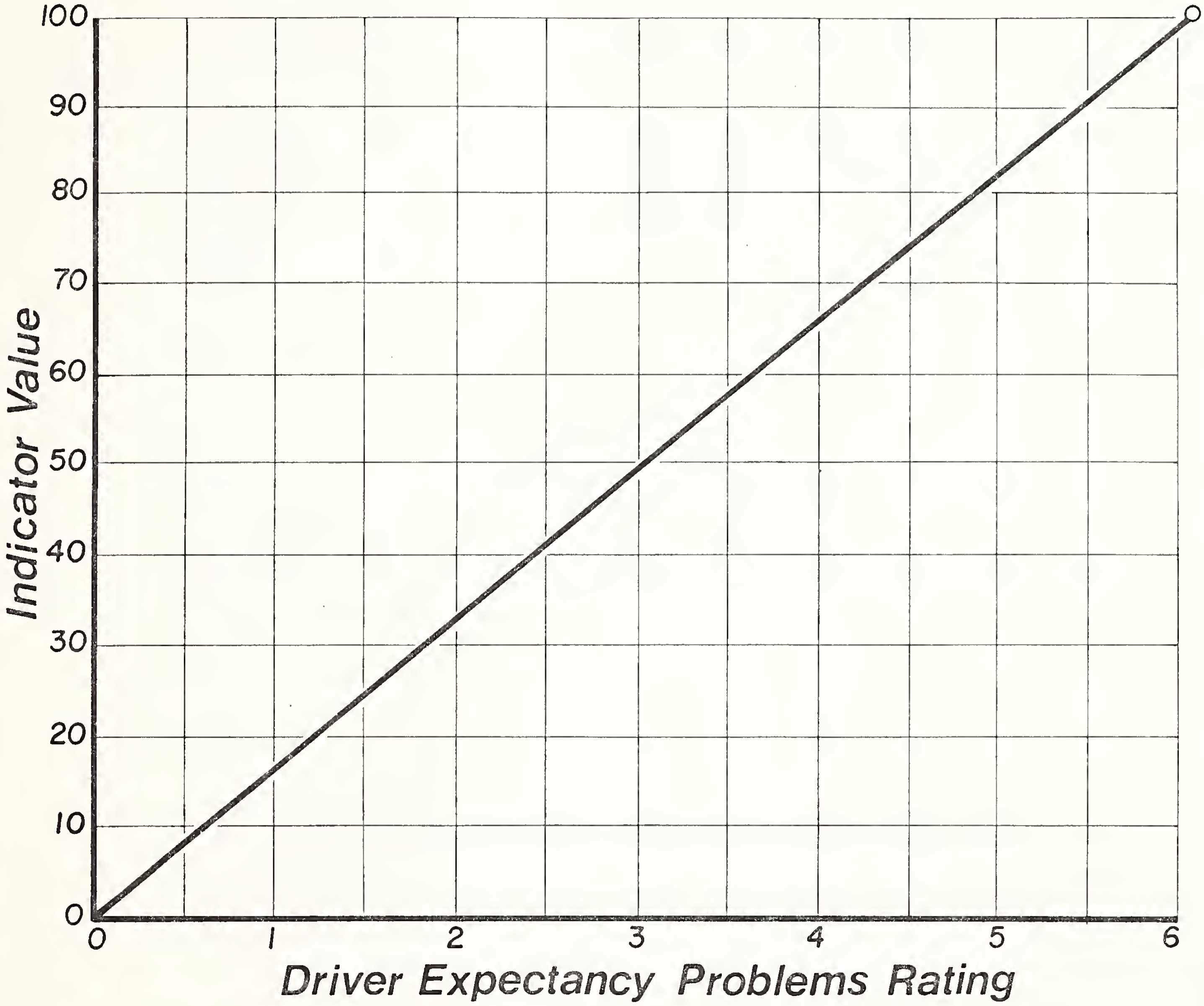
4

5

6 Very unusual situation; will surprise many unfamiliar drivers.
Driver required to make major changes in driving tactics from those employed over past few miles.
At least a "near accident" almost expected if driver is even moderately inattentive; evasive actions likely to be required.
Intended pathway(s) confusing under fairly normal traffic or lighting conditions.
Other traffic, or lack of it, aggravates situation and misleads driver or deprives him of important cues.

Approach	Rating						
	0	1	2	3	4	5	6
A							
B							
C							
D							

FIGURE A8



INDICATOR VALUES FOR
DRIVER EXPECTANCY

FIGURE A9

INFORMATION SYSTEM DEFICIENCIES RATING FORM

Ratings

0 Information for required decisions complete and unambiguous.
Signs, markings, delineation in good repair, clean, highly visible.
"Positive guidance" leads driver to appropriate path; makes "error" difficult.
Approach speeds of most drivers are appropriate.
Light decision load; easy and obvious.

1

2

3 Some information lacking or somewhat misleading.
Signs should be moved or augmented for better visibility or to provide more decision time.
Visibility of signs, marking, and delineation barely adequate.
Medium decision load; average driver will be able to handle situation, but may be a little uncomfortable.

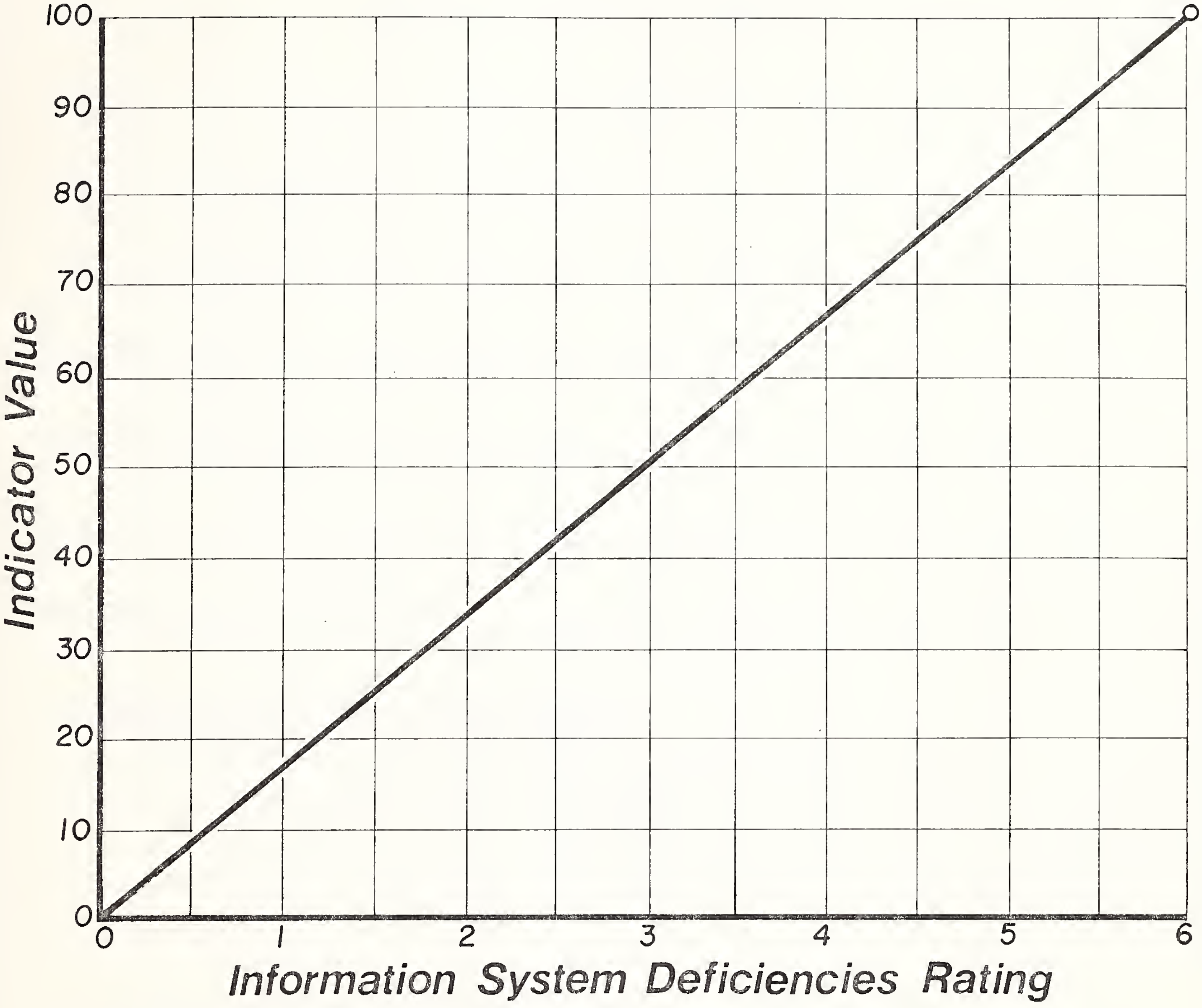
4

5

6 Important information missing.
Complete new "information system" needed – design and installation.
Present signs and markings in very poor condition; need replacement.
Speed limit and/or advisory speed needed; either missing or totally inappropriate at present.
"Positive guidance" on appropriate path lacking; a clutter of negative delineation only.
Heavy decision load; complete attention of average driver required; a "tense" situation at best.

Approach	Rating						
	0	1	2	3	4	5	6
A							
B							
C							
D							

FIGURE A10



INDICATOR VALUES FOR INFORMATION SYSTEM DEFICIENCIES

FIGURE A11

BENEFIT / COST RATIO WORKSHEET

Location: ____________________ Milepost: ____________________

Improvement Description: ______________________________________

____

Estimated Service Life ____________________ Years = T

Compounded Interest Rate ____________________ % = R

Current 19 ___ ADT ____________________

Time Frame for Accident Data: From ________ To ________ = ________ Years

I. ANNUAL COST FOR THE IMPROVEMENT:

1. C = Capital Cost for Improvement $ ____________________
2. K = Capital Recovery Factor = $K = \frac{R(1 + R)^T}{(1 + R)^T - 1}$ = ____________
3. M = Change in Annual Maintenance or Operation Cost $ ____________________
4. Annual Cost = (C K) + M = $ ____________________

II. ANNUAL BENEFIT OF THE IMPROVEMENT:

1. ADT_a = Average Daily Traffic After Improvement: ____________________
2. ADT_b = Average Daily Traffic Before Improvement: ____________________
3. I/F = Ratio of Injuries to Fatalities for the Class of Highway Involved: ____________
4. $Q = \frac{* + (I/F)**}{1 + I/F}$ = ____________ = ____________ = ____________

   * Current cost of a fatal accident from National Safety Council memo No. 113 = $ ____________________

   ** Cost of an injury accident = $____________________

5. Afi = Annual average number of fatal accidents and injury accidents combined at the location which will be affected by the improvement =

   $\frac{\text{No.}}{\text{Years}}$ = ____________________ = ____________________

FIGURE A12

6. Apd = Annual Average Number of Property Damage Accidents at the Location =

$\frac{\text{No.}}{\text{Years}}$ = ____________________ = ____________________

7. Pfi = Expected Percentage Reduction of Fatal and Injury Accidents by Improvement =

__________ %

8. Ppd = Expected Percentage Reduction of Property Damage Accidents by Improvement =

__________ %

a. P_1 = Largest percentage reduction in accident of any one of the improvements.

b. P_2 = Second largest percentage reduction in accidents of any of the improvements.

c. P_3 = Third largest percentage reduction in accidents of any of the improvements.

d. Pfi and Ppd for location where more than one improvement will be used in combination = $P_1 + \left(\frac{100 - P_1}{100}\right) P_2 + \left(\frac{100 - P_1}{100}\right)\left(\frac{100 - P_2}{100}\right) P_3 + \ldots$

9. Annual Benefit $= \frac{ADT_a}{ADT_b} \left[Q\,(Afi)\,pfi + {}^{***}\,(Apd)\,Ppd \right]$ = ____________________

*** Cost of a property damage accident = $____________________

III. BENEFIT / COST RATIO = $\frac{\text{Annual Benefit}}{\text{Annual Cost}}$ = ______________ = ______________

FIGURE A12 (Continued)

RELATIVE SEVERITY INDEX
BY TYPE OF ACCIDENT *

Multi-Vehicle, At Intersection	Urban	Rural
Entering at angle	$4,300	$14,400
From same direction – both going straight	2,800	5,100
From same direction – one turn, one straight	2,500	5,100
From same direction – one stopped	3,800	5,200
From same direction – all others	2,000	6,300
From opposite direction – both going straight	4,000	20,000
From opposite direction – one left turn, one straight	4,400	15,400
From opposite direction – all others	2,700	3,800
Not stated	3,800	5,200
Multi-Vehicle, Non-Intersection		
Going opposite direction – both moving	$4,400	$19,600
Going same direction – both moving	2,900	8,100
One car parked	1,600	2,400
One car stopped in traffic	4,200	6,800
One car entering parked position	1,900	2,300
One car leaving parked position	1,200	2,700
One car entering alley or driveway	3,400	6,000
One car leaving alley or driveway	2,000	4,400
All others	1,700	7,600
Not stated	3,400	6,000
Motor Vehicle with Pedestrian, At Intersection and Non-Intersection		
Vehicle going straight	$20,000	$49,000
Vehicle turning right	13,600	11,200
Vehicle turning left	17,100	11,200
Vehicle backing	20,600	11,200
All others	14,500	11,200
Not stated	11,200	11,200

* FHWA-RD-77-87 "Identification of Hazardous Locations"

TABLE A1

Single Vehicle, at Intersection	Urban	Rural
Collision with train	$26,700	$39,100
Collision with bicycle	13,100	31,900
Injury in vehicle, jacknifed	5,200	2,000
Collision with fixed object in road	5,500	7,000
Overturned in road	9,200	7,500
Left road	5,200	12,300
Single Vehicle, Non-Intersection		
Collision with train	$26,700	$39,100
Collision with bicycle	13,100	31,900
Injury in vehicle, jacknifed	5,200	2,000
Collision with fixed object in road	6,300	9,200
Overturned in road	10,000	9,400
Left road at curve	7,600	12,400
Left road on straight road	5,200	10,500
Other One Motor Vehicle, At Intersection and Non-Intersection		
Fell from moving vehicle	$15,000	$57,200
Collision with animal	4,800	1,800
Collision with other object	4,700	4,400
All others	5,200	2,000
Not stated	3,200	3,400

TABLE A1 (Continued)